SOIL SURVEY OF

Yellowstone County, Montana

United States Department of Agriculture
Soil Conservation Service
and
United States Department of the Interior
Bureau of Indian Affairs
In cooperation with
Montana Agricultural Experiment Station

Issued March 1972

Major fieldwork for this soil survey was completed in 1965. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1965. This survey was made cooperatively by the Soil Conservation Service, the Bureau of Indian Affairs, and the Montana Agricultural Experiment Station. It is part of the technical assistance furnished to the Yellowstone Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Yellowstone County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the windbreak group and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about the use and management of the soils from the soil descriptions and from the discussions of the range sites and windbreak groups.

Foresters and others can refer to the section "Use and Management of the Soils for Windbreaks," where the soils of the county are grouped according to their suitability for trees.

Ranchers and others can find, under "Use and Management of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers, builders, and community planners can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Yellowstone County, Montana may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: Harvesting silage corn on irrigated soils in the Yellowstone River Valley.

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, AND UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF INDIAN AFFAIRS, IN COOPERATION WITH THE MONTANA AGRICULTURAL EXPERIMENT STATION

YELLOWSTONE COUNTY, located in the unglaciated semiarid high plains of south-central Montana, has an area of 1,686,400 acres or about 2,611 square miles. Custer at the east boundary of the county is about 65 miles from Laurel at the west boundary. Distances by air from Billings, the county seat, to the principal cities in the State are shown in figure 1.

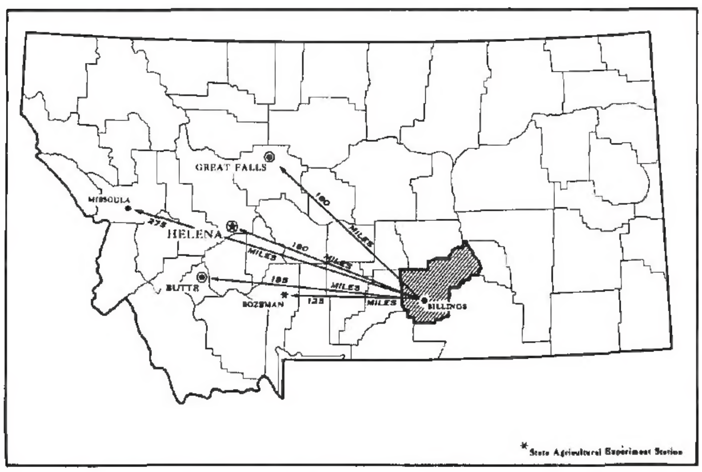

Figure 1.—**Location of Yellowstone County in Montana.**

General information about the county can be found in the section "General Nature of the County" at the back of this survey.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Yellowstone County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots (*9*).[1]

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedure. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Elso and Grail, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Grail clay loam, 2 to 4 percent slopes, is one of several phases within the Grail series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of

[1] Italic numbers in parentheses refer to Literature Cited, p. 131.

Yellowstone County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Danvers-Judith complex, 7 to 15 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Toluca and Wanetta clay loams, 0 to 2 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Riverwash is a land type in Yellowstone County.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Yellowstone County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational areas, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Yellowstone County are discussed in the following pages.

Soils of Shale and Sandstone Uplands

The soils of the shale and sandstone uplands are mainly shallow to moderately deep, well drained, and undulating to steep. They are mostly north of the Yellowstone River, but they also occur in the southwestern and southeastern parts of the county.

Elevation ranges from 2,700 to 5,000 feet. Annual precipitation is 10 to 16 inches. The native vegetation is dominantly grasses and low shrubs, though scattered conifers grow in areas of higher rainfall. These soils are used for grazing and for grain in a wheat-fallow rotation.

Eight soil associations in Yellowstone County are on the shale and sandstone uplands.

1. Bainville-Elso-McRae association: Undulating to hilly, moderately deep and shallow loams and clay loams underlain by silt loam to silty clay loam, and deep soils that are loam throughout; on shale and sandstone uplands

This association of undulating to hilly soils is on the plain north of the Yellowstone River. The dissected landscape is a pattern of winding valleys and coulees separated by knolls and ridges (fig. 2). The larger valleys are cut 50 to 150 feet below the highest ridges. The valleys are 1/8 to 1/4 mile wide and are filled with deep deposits of alluvium on fans, foot slopes, and narrow terraces. Scattered shale outcrops and thin sandstone ledges are along the rim of the deep valleys. In many places shale crops out on the bottom of the narrow tributary coulees. Streams flow intermittently when the snow melts in spring or after summer thunderstorms. Drainage is into the Yellowstone River. The vegetation consists mostly of grasses, shrubs, and scattered pine and juniper trees in deep coulees or on steep north slopes. A few cottonwood trees grow on the bottom of the valleys.

Elevation ranges from 2,700 to 3,600 feet. The annual precipitation is 10 to 13 inches, mean annual temperature is 44 to 48° F., and there are 125 to 130 frost-free days.

This association makes up 30 percent of the county. It is 45 to 60 percent Bainville soils, 20 to 35 percent Elso soils, and 10 to 20 percent McRae soils. The rest is minor soils.

The major soils in this association are well drained. The Bainville soils are on smooth broad ridges and the sides of shallow drainageways where slopes are 4 to 25 percent. Their grayish-brown loam surface layer is underlain by a grayish-brown and light grayish-brown heavy silt loam substratum. Bedrock is at a depth of 20 to 40 inches.

The Elso soils have slopes of 20 to 35 percent and occur around shale and sandstone outcrops. Their thin, yellowish-brown light clay loam surface layer is underlain by a yellowish-brown and pale-olive clayey substratum. Bedrock is at a depth of 10 to 20 inches.

The McRae soils are deep and occur on the alluvial terraces, fans, and foot slopes along the lower sides and bottoms of valleys. They have a grayish-brown loam surface layer and subsoil.

Among the minor soils in this association are Worland, Travessilla, and Lohmiller soils. The Worland soils are on ridges and knolls without sandstone outcrops. The Travessilla soils are on ridges and knolls where hard sandstone crops out and are along the top of sandstone ledges that form the rim of deep valleys. The Lohmiller soils are on terraces, fans, and valley sides.

Because the soils are steep and shallow to bedrock and precipitation is low, this association is better suited to grazing beef cattle than to crops. Forage plants grow moderately well on the Bainville and McRae soils and poorly on the Elso soils. Most areas of the Bainville and McRae soils that were dryfarmed have been seeded to hay and pasture.

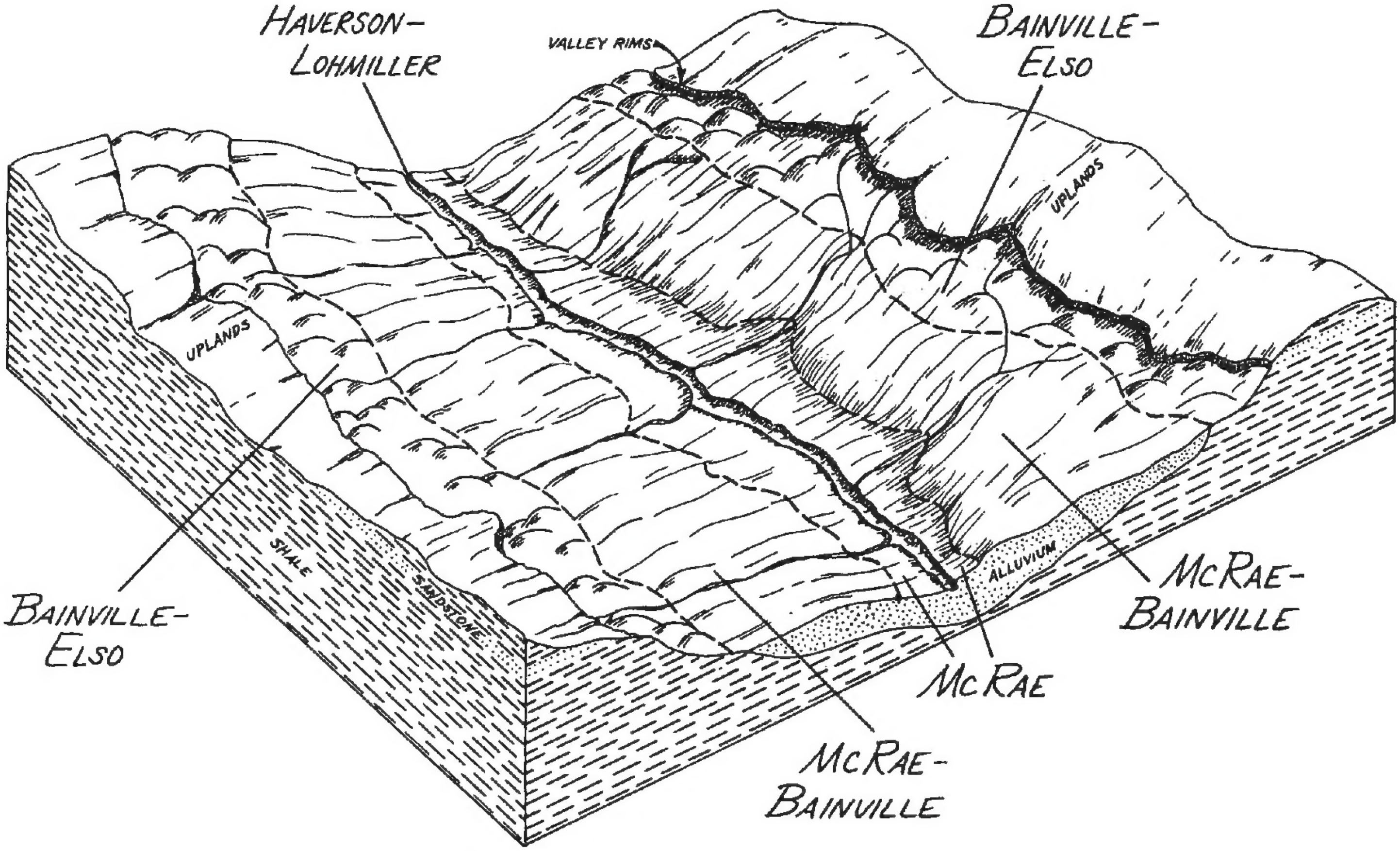

Figure 2.—Typical landscape of the Bainville-Elso-McRae association.

Antelope and a few deer are the main game animals in this association. Sage grouse use the areas in sagebrush. Drilled wells are the most reliable source of water.

2. Cushman-Bainville association: Undulating to rolling, moderately deep loams that have a clay loam subsoil or are underlain by clay loam and silt loam; on shale uplands

This soil association of undulating to rolling soils is on uplands. It is mostly in the northwestern part of the county, but small areas are scattered through the northern half. The bedrock is silty and loamy shale and sandstone. Drainageways are shallow and less than 500 feet wide. The vegetation consists mostly of grasses, forbs, and shrubs.

Elevation ranges from 3,300 to 4,000 feet. The annual precipitation is 11 to 14 inches. The mean annual temperature is 45 to 47° F., and there are 120 to 130 frost-free days.

This association makes up 7 percent of the county. It is about 45 percent Cushman soils and 40 percent Bainville soils. The rest is minor soils.

The major soils in this association are well drained. The Cushman soils are gently sloping to moderately sloping. They have a grayish-brown loam surface layer and a light brownish-gray clay loam subsoil.

The Bainville soils are sloping and occur on the tops of ridges and knolls that are the crests of undulating areas. They have a grayish-brown loam surface layer and a substratum that is mostly grayish-brown heavy silt loam. Depth to the underlying shale and sandstone ranges from 20 to 40 inches in the major soils.

Among the minor soils are McRae and Haverson soils in drainageways, and Worland and Elso soils on uplands.

The soils in most of this association are or have been used for dryfarmed crops. The main crops are winter wheat and barley. In the drier northeastern part of the county, much of this association that was used as cropland is now grazed by beef cattle or is reseeded to crested wheatgrass for hay and pasture.

Antelope and sage grouse are the main wildlife. No streams flow in the association. Stock water is supplied by wells and surface reservoirs.

3. Worland-Bainville-Travessilla association: Rolling to hilly, moderately deep and shallow fine sandy loams and loams underlain by sandy loam to clay loam; on sandstone and shale uplands

This association of rolling to hilly soils is on the dissected sandstone and loamy shale uplands in the northeast quarter of the county. Ridges 2 miles wide separate valleys that are cut 50 to 200 feet below the ridgetops. The valleys, about a half mile wide, have steep side slopes. On the upper sides of the deeper valleys and side drainageways are outcrops of sandstone 20 to 50 feet thick. Sandstone outcrops and low ledges of shale and sandstone are scattered throughout the association between the main valleys. Deep soils lie in the main drain-

ageways and on the fans at the mouth of tributary drainageways. Streams flow only when the snow melts rapidly or after hard rains in summer. The vegetation consists mainly of grasses, sagebrush, and sumac. Scattered pine and juniper trees grow along the rock ledges and in the deep coulees. A few cottonwood trees grow along the stream channel of the main valleys.

Elevation ranges from 3,000 to 3,800 feet. The annual precipitation is 11 to 13 inches, mean annual temperature is 45 to 47° F., and there are 125 to 130 frost-free days.

This association occupies about 5 percent of the county. It is about 40 percent Worland soils, 30 percent Bainville soils, and 15 percent Travessilla soils. The rest is minor soils.

All the soils in this association except the Worland are well drained. The Worland soils are well drained and somewhat excessively drained. They are on ridges and knolls that have outcrops of soft sandstone. Their surface layer is light yellowish-brown fine sandy loam, and their substratum is mostly light yellowish-brown and pale-yellow fine sandy loam. Bedrock is at a depth of 20 to 40 inches.

The Bainville soils are on smooth broad ridges and knolls that do not have sandstone outcrops. They have a grayish-brown loam surface layer and a substratum that is mostly grayish-brown loam and heavy silt loam. Bedrock is at a depth of 20 to 40 inches.

The Travessilla soils are on ridges and knolls where hard sandstone crops out and are along the top of sandstone ledges that form the rim of deep valleys. They have a thin, brown fine sandy loam surface layer. Their substratum is yellowish-brown fine sandy loam and partly weathered sandstone fragments. Hard sandstone is at a depth of 10 to 20 inches.

Among the minor soils in the association are McRae, Glenberg, and Haverson soils and patches of barren Rock land. The McRae and Haverson soils are on fans and terraces in the wide stream valleys. The Glenberg soils are on smooth slopes of the valley sides below sandstone outcrops. The barren Rock land occurs out of the main valleys.

Because of the low annual precipitation, steep slopes, and shallow soils, nearly all of this association is used only for grazing beef cattle. Forage plants grow moderately well on the Worland and Bainville soils and poorly on the Travessilla soils. Much of the acreage of the Worland and Bainville soils was used for dryfarmed crops, but nearly all of this is now reseeded to grass. Some areas of the McRae, Haverson, and Glenberg soils in the wide valleys are used for dryfarmed crops and for hay.

Antelope, deer, and sage grouse are the main wildlife in this association. Recreation development is limited by lack of water and low esthetic value. Stock water is supplied by wells and surface reservoirs.

4. Bainville-Travessilla-Rock land association: Moderately steep and steep, moderately deep and shallow loams and fine sandy loams underlain by clay loam to fine sandy loam, and sandstone and shale Rock land

This soil association of moderately steep to steep soils is on uplands northeast of Shepherd and on the south slopes of the Bull Mountains. The sandstone and silty shale bedrock has been dissected into narrow, smooth-topped ridges that are separated by deep, narrow coulees and dry stream valleys. Large, thick masses of sandstone crop out on the sides of the coulees and valleys. The most prominent features of the landscape are the vertical ledges of sandstone 20 to 50 feet thick. These ledges resemble stairsteps. They begin just above the bottom of the valley and end at its rim. In some places three or four of these sandstone ledges crop out at different levels in a horizontal distance of 1 or 2 miles. Differences in elevation between successive ledges are 50 to 150 feet. The larger stream valleys contain thick alluvial deposits that surround knolls and hills consisting of shallow to moderately deep soils. The drainageways are tributaries of the Yellowstone River. The headwaters of Buffalo, Mill, Antelope, Rock, Railroad, and Pompeys Pillar Creeks are in this association.

The vegetation consists of grasses, sagebrush, rabbitbush, skunkbush, sumac, redcedar, and ponderosa pine. Trees are most common on the north slopes and the sides of deep coulees at higher elevations.

Elevation ranges from 3,500 to 5,000 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 48° F., and the frost-free season is 120 to 130 days.

This association makes up about 8 percent of the county. It is about 40 percent Bainville soils, 25 percent Travessilla soils, and 20 percent Rock land. The rest is minor soils.

The Bainville soils are moderately steep and occur on ridgetops and knolls in the wide valleys. They are well drained. They have a thin, grayish-brown loam surface layer and a loam substratum containing shale fragments below a depth of 20 inches. They are underlain by platy shale and sandstone at a depth of about 30 inches.

The Travessilla soils are somewhat excessively drained. They lie immediately above the sandstone ledges and around scattered sandstone outcrops. They have a thin, brown fine sandy loam surface layer. Their substratum is yellowish-brown fine sandy loam and partly weathered sandstone fragments. Hard sandstone is at a depth of 10 to 20 inches.

Rock land consists of the sandstone ledges and escarpments and exposed shale below the ledges. Also below the ledges, and broken from them, are large blocks of sandstone.

Among the minor soils are sloping to moderately steep Apron soils on uplands and McRae and Lohmiller soils on the sides and bottoms of the widest valleys.

Because of the steep slopes, low annual precipitation, and shallow soils, nearly all of this association is used for grazing beef cattle. Forage plants grow poorly on the Travessilla soils but moderately well on the Bainville soils. Small areas of the Bainville soils on the wide ridgetops, and the deep soils in the main valleys are used for dryfarmed small grains and hay.

Rabbit, deer, antelope, sage grouse, and turkey are the main wildlife in this association. Pumped wells are the most reliable source of livestock water.

5. Wormser-Lavina-Razor association: Undulating to rolling, moderately deep and shallow soils that have a dominantly clay loam subsoil; on sandstone and shale uplands

This association of undulating to rolling soils is on plateaus and uplands in the western part of the county. Most drainageways are shallow and carry water only

when snow melts rapidly or when rains are heavy. A few valleys have steep sides. Fivemile Creek drains areas north and west of Billings, and Canyon Creek drains areas just north and northwest of Billings. Short drainageways that empty into a dry lake basin drain the area southwest of Broadview. The native vegetation is mostly grasses, sagebrush, and yucca. A few cedar and ponderosa pine trees grow in the steep-sided valleys.

Elevation ranges from 3,200 to 3,800 feet. The annual precipitation is 13 to 14 inches. The mean annual temperature is 44 to 46° F., and there are 120 to 125 frost-free days.

This association occupies about 3 percent of the county. It is 55 percent Wormser soils, 15 percent Lavina soils, and 15 percent Razor soils. The rest is minor soils.

The major soils are in various positions, but all of them are well drained. Wormser soils have a thin, grayish-brown clay loam surface layer, a brown clay loam subsoil, and a pale-yellow clay loam substratum. Depth to shale and sandstone bedrock is 24 to 36 inches.

Lavina soils have a brownish loamy surface layer. The subsoil of dark grayish-brown clay loam and dark-brown light clay is directly underlain by shale and sandstone at a depth of 8 to 20 inches. In most places Lavina soils are around barren rock outcrops. Cultivated Lavina soils have thin sandstone chips on the surface.

Razor soils have a thin, pale-brown loam surface layer, a dark-brown to pale-brown heavy clay loam subsoil, and a light yellowish-brown clay loam substratum. Depth to soft and semihard shale is 20 to 40 inches.

Among the minor soils are the Midway, Travessilla, and Cushman soils. The Midway soils are on eroded uplands. The Travessilla soils lie immediately above the sandstone ledges and around scattered sandstone outcrops. The Cushman soils are in concave areas and are nearly level to gently sloping.

Wormser and Razor soils are used for small grains dryfarmed in a crop-fallow system. Lavina soils are used for range, but forage plants grow poorly, and sites suitable for stock-water ponds are few. Springs do not occur, and wells are generally drilled in the deepest valleys.

Some of the wide valleys around Billings are used for homesites. Among the wildlife in this association are antelope, rabbit, and sage grouse. Deer live in the deep, forested valleys.

6. Pierre-Lismas-Kyle association: Rolling to moderately steep, shallow to deep silty clays and clays that are underlain by clay; on clay shale uplands

This association of rolling to moderately steep soils occurs on eroded uplands underlain by clay shale. The valley slopes are thick deposits of clay alluvium that washed from the shale bedrock. About one-third of the association lies between Shepherd and Acton. The rest is scattered along the south side of the Yellowstone River and in the southern part of the county. South of the Yellowstone River barren shale crops out on steep hills cut by many gullies. Stones and pebbles are common on the surface along the Yellowstone River in areas of the shale uplands that were terraces. The intermittent drainageways are tributaries of the Yellowstone and Bighorn Rivers. The native vegetation is mostly grasses and sagebrush, shrubs, and a few cedars.

Elevation ranges from 3,000 to 4,800 feet. The annual precipitation is 11 to 14 inches. The mean annual temperature is 45 to 48° F., and there are 120 to 125 frost-free days.

This association occupies about 11 percent of the county. It is 35 percent Pierre soils, 35 percent Lismas soils, and 20 percent Kyle soils. The rest is minor soils.

Pierre soils are on smooth, broad ridges, hills, and parts of the landscape not deeply cut by drainageways. The surface layer is light olive-brown silty clay, the subsoil is olive clay, and the substratum is olive and olive-gray clay. Depth to shale bedrock is 20 to 40 inches.

The Lismas soils are on narrow, steep ridges and the sides of deep, narrow drainageways. The surface layer and most of the substratum are light olive-gray clay. The substratum contains many shale fragments. Depth to shale bedrock is 10 to 20 inches.

Kyle soils are in troughs between low ridges and on the sides and bottoms of wide valleys. The surface layer is grayish-brown silty clay, and the substratum is grayish-brown clay. Very gravelly loam, sand, or clay shale lie below a depth of 40 inches.

Among the minor soils are Bone, Vananda, and Arvada soils on valley bottoms and Sage soils on the large drainageways west of Shepherd.

This association is used mostly for grazing beef cattle. Forage plants grow poorly on the Lismas soils and moderately well on the Pierre and Kyle soils. Runoff water stored in small reservoirs is the most reliable source of stock water. Some Pierre and Kyle soils are used for wheat and barley dryfarmed in a summer-fallow system, but crop growth depends on the amount of precipitation during the growing season. Much water is available along the southern boundary when snow melts and when rains are heavy.

Among the wildlife in the association are sage grouse, sharptail grouse, rabbit, and a few antelope and deer.

7. Midway-Heldt association: Sloping to moderately steep, moderately deep and deep soils that are dominantly clay loam and silty clay loam throughout; on uplands and in valleys

This association of sloping to moderately steep soils is on alluvial fans and terraces and on dissected uplands underlain by clay shale, mostly in the southeastern part of the county where high, narrow ridges and hills separate wide valleys. In the valleys are isolated, low hills and knolls of shallow Midway soils surrounded by deep Heldt soils on alluvial fans and terraces. The area is drained by the headwaters of East Fork and Telegraph Creeks. The native vegetation is grasses, broom snakeweed, and sagebrush.

Elevation ranges from 2,900 to 3,600 feet. The annual precipitation is 13 to 16 inches. The mean annual temperature is 46 to 48° F., and there are 120 to 125 frost-free days.

This association occupies about 2 percent of the county. It is 45 percent Midway soils, 30 percent Heldt soils, and 15 percent Work soils. The rest is minor soils.

The Midway and Heldt soils are well drained. The Midway soils occur on the tops and steep sides of ridges and hills. The surface layer is pale-olive clay loam underlain by pale-yellow heavy clay loam and a pale-olive, partly weathered platy shale substratum. Depth to the partly weathered shale is less than 20 inches.

The Heldt soils are on fans, terraces, and valley slopes. The surface layer is grayish-brown light silty clay loam, and the subsoil is grayish-brown silty clay loam. The substratum is light brownish-gray heavy silty clay loam in the upper part. Depth to bedrock is over 48 inches.

Among the minor soils are Work and Keiser soils on fans, terraces, and valley sides, and McRae soils on broad stream terraces and valley sides.

Most of this association is in the Crow Indian Reservation where it is used for grazing beef cattle. Forage plants grow poorly on the Midway soils and moderately well to well on the Heldt and Work soils. Suitable sites and sufficient runoff water are available for stock-water ponds. Heldt and Work soils are suited to crops dryfarmed in a summer-fallow system.

Among the wildlife in this association are sage grouse, sharptail grouse, rabbit, and a few deer and coyotes.

8. Maginnis-Absarokee association: Undulating to steep, shallow and moderately deep soils that have a dominantly clay loam subsoil; on uplands

This association of undulating to steep soils occurs on a deeply dissected plateau that is underlain by hard shale and sandstone. About three-fourths of the association is in the southwestern part of the county and the rest is in the southeastern part. Steep-sided valleys 1,000 to 1,800 feet wide and 150 to 300 feet deep are cut into the plateau. The land slopes gently from 3,000 feet at the Yellowstone River to 4,800 feet at the southern county line. Streams flow only when snow melts and when rains are heavy. The main drainageways are Duck and Blue Creeks, which empty into the Yellowstone River, and Spring Creek, a tributary of Clarks Fork of the Yellowstone River. The native vegetation is grasses and sagebrush. Cottonwoods, wild roses, and some junipers grow in the main valleys.

The annual precipitation is 14 to 16 inches. The mean annual temperature is 45 to 47° F., and there are 110 to 125 frost-free days.

This association occupies about 7 percent of the county. It is 40 percent Maginnis soils, and 25 percent Absarokee soils. The rest is minor soils.

The Maginnis soils are stony and steep. They occur on the sides and bottoms of deep drainageways, on the valley rims, and on the upper sides of main valleys where shale and sandstone crop out on the vertical parts of the valley sides.

The surface layer of Maginnis soils is grayish-brown channery clay loam, and the subsoil is brown very channery heavy clay loam. The substratum is sandy shale, and bedrock is at a depth of 4 to 15 inches.

The Absarokee soils are on smooth plateaus between deep drainageways. The surface layer is grayish-brown loam. The brownish subsoil is loamy and clayey. The substratum is light yellowish-brown very channery light clay loam. The depth to hard sandstone is 20 to 40 inches.

The minor soils are in the Amherst, Grail, and Farland series. The Amherst soils are on plateau surfaces, on the edges of shallow drainageways, and on the narrow ridges where drainageways intersect. The Grail soils are on terraces, fans, and valley sides. The Farland soils are on uplands and are nearly level to gently sloping.

The Absarokee and Amherst soils not in the Crow Indian Reservation are used for small grains dryfarmed in a crop-fallow system. The Maginnis soil is used only for grazing beef cattle. Forage plants grow well on Absarokee soils, moderately well on Amherst soils, and poorly on Maginnis soils. The Absarokee soils have few sites suitable for stock-water ponds. Springs and seeps in the main valleys supply adequate water for livestock on the Maginnis soils.

Native wildlife includes rabbit, sage grouse, and sharptail grouse; pheasant and deer are in the main valleys.

Soils of River Terraces, Low Alluvial Fans, and Flood Plains

The soils of the river terraces and low alluvial fans are dominantly deep, well drained and moderately well drained, and nearly level to gently sloping. The soils on the flood plains not only are subject to overflow but also have a water table that fluctuates near the surface. The soils in this group are along major streams and on low river terraces throughout the county. The broadest area is between Billings and Laurel.

Elevation ranges from 2,900 to 3,400 feet. Annual precipitation is 11 to 13 inches. Most of the area is irrigated or used for community development. All climatically adapted crops are grown under irrigation. The saline and alkali soils are used for grazing and for irrigated crops tolerant of salt and alkali.

Three of the soil associations in the county are on river terraces, low alluvial fans, and flood plains.

9. McRae-Lohmiller-Keiser association: Gently sloping to sloping, deep loams to silty clays underlain by clay to fine sandy loam; on high terraces and fans

This association of gently sloping to sloping soils is on terraces and fans built up by large intermittent streams that flow into the Yellowstone River Valley. The association occurs between Billings and Laurel and northeast of Shepherd and Huntley. The smooth landscape is broken only between terrace levels or where widely spaced drainageways dissect the terraces. Two such drainageways are on Canyon Creek and Custer Coulee. The native vegetation is mostly grasses, sagebrush, and rabbitbrush.

Elevation is about 3,100 feet. The annual precipitation is 11 to 13 inches. The mean annual temperature is about 47° F., and there are 125 to 130 frost-free days.

This association occupies 7 percent of the county. It is 40 percent McRae soils, 25 percent Lohmiller soils, and 20 percent Keiser soils. The rest is minor soils.

The major soils are well drained. The McRae soils are on fans close to uplands that border river valleys. The surface layer and subsoil are grayish-brown loam, and the substratum is pale-yellow or pale-olive loam to fine sandy loam. Depth to shale bedrock is 48 to 72 inches.

The Lohmiller soils are on low terraces and along intermittent stream channels that drain the terraces. The surface layer is grayish-brown silty clay loam to silty clay. The substratum is stratified light olive-gray clay, pale-olive loam or heavy clay loam, and pale-yellow fine sandy loam. Depth to bedrock is more than 60 inches.

The Keiser soils are on high terraces underlain by gravel. The surface layer is grayish-brown silty clay loam, the subsoil is brown silty clay loam or silty clay, and the substratum is light-gray silty clay loam to silt loam.

Among the minor soils are Thurlow, Fort Collins, and Laurel soils. Thurlow soils are on river terraces and fans where intermittent streams flow into the river valleys. Fort Collins soils are on fans, terraces, and the sides of large stream valleys. Laurel soils that have been seeped by overflow from irrigation canals occur in the river valleys.

Most of this association is irrigated. The major soils are easily managed, and crop growth is good. On outer margins of the river valleys, small grains are dryfarmed. In winter, beef cattle graze crop residues and hay crops. Some areas west of Billings are used for housing sites.

The main wildlife in this association is pheasant.

10. Vananda-McKenzie-Arvada association: Level to gently sloping, deep clays to loams over clay; on terraces and fans and in dry lake basins

This association of level to gently sloping soils is on dry lake basins, terraces, and fans in the northwest corner of the county and on terraces northeast of Huntley. Distinct drainageways occur only at the outer edges of lake basins and on fans. They carry water only when snow melts or rains are heavy. The lake basins are undrained. The native vegetation is mostly western wheatgrass, sagebrush, and greasewood.

Elevation is about 3,000 feet. The annual precipitation is 11 to 13 inches, the mean annual temperature is 46 to 48° F., and there are 125 to 130 frost-free days.

This association occupies about 3 percent of the county. It is 50 percent Vananda soils, 20 percent McKenzie soils, and 20 percent Arvada soils. The rest is minor soils.

Vananda soils are well drained and level to gently sloping. The surface layer is grayish silty clay, and the subsoil is olive-gray and pale-olive heavy clay. The substratum is mostly clayey and ranges from pale olive to pale yellow. Depth to bedrock is more than 60 inches.

McKenzie soils are moderately well drained. They occur in areas where water ponds, and greasewood and sagebrush do not grow. In these soils, gray clay extends from the surface to a depth of 38 inches. Below that depth is light olive-gray and pale-yellow clay. Depth to bedrock is more than 60 inches.

Arvada soils are moderately well drained and nearly level. The vegetation is spotty, and slickspots occur. The surface layer is light-gray loam, and the subsoil is brownish to grayish clay. The substratum is grayish light clay loam, loam, and fine sandy loam. Depth to bedrock is more than 40 inches.

Among the minor soils are Bone soils on fans, terraces, and dry lake basins, and Kyle soils on terraces of the major river valleys.

Because the major soils are clayey in the surface layer and subsoil, are very slowly permeable, and contain sodium and other salts, they are better suited to range than to farming. The Vananda and Arvada soils in the valley of the Yellowstone River are irrigated to small grains, corn for silage, hay and pasture, but crop growth is poor. McKenzie soils do not occur in the irrigated valley around Huntley and Nibbe.

The wildlife is mainly rabbit, sage grouse, and antelope. Ducks live near stock-water reservoirs and on flooded areas of McKenzie soils.

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11. Haverson association: Level to gently sloping, deep loams that are underlain by loam and silt loam; on flood plains and terraces

This association of level to gently sloping soils is on the flood plains and terraces of the Big Horn River, the Yellowstone River, Clarks Fork of the Yellowstone River, and Pryor Creek. Sandy and gravelly soils occur along river channels and on islands. Seeped and wet soils occur in oxbows and meanders. The native vegetation is mostly cottonwoods, wild roses, buckbrush, and grasses. On flood plains the water table is within 60 inches of the surface, and the soils are flooded when snow melts in spring. Willows, cattails, and sedges grow along water-filled oxbows.

Elevation ranges from 2,900 to 3,400 feet. The annual precipitation is 11 to 13 inches, the mean annual temperature is 46 to 48° F., and there are 125 to 135 frost-free days.

This association occupies about 5 percent of the county. It is 65 percent Haverson soils, and the rest is minor soils.

The Haverson soils are well drained and occur on terraces. The surface layer is grayish-brown loam. It is underlain by a light brownish-gray and light-gray loamy substratum. Depth to loose sand and gravel is more than 60 inches.

Among the minor soils are Lohmiller soils on terraces, Glenberg soils on flood plains, and Alluvial land, both gravelly and mixed, on flood plains and islands.

The soils on flood plains and islands are used mostly for grazing beef cattle. Those on terraces and in the smaller stream valleys are irrigated or dryfarmed. Dryfarmed small grains and hay and pasture plants grow moderately well. Irrigated sugar beets, dry beans, corn for silage, alfalfa, and small grains grow well.

The main kinds of wildlife are pheasant, deer, raccoon, and rabbits. Ducks and geese live in sloughs and on islands and sandbars. The rivers contain rainbow trout, sauger, white fish, suckers, and carp.

Soils of High Terraces and Benches

The soils of the high terraces and benches are dominantly moderately deep to deep and clayey and loamy. These soils are well drained and nearly level to steep. They are mostly on high terraces along rivers and on benches south of the Yellowstone River.

Elevation ranges from 3,000 to 4,200 feet. Annual precipitation is 11 to 16 inches. The native vegetation is grass, sagebrush, and greasewood. These soils are used for grazing, for grain dryfarmed in a grain-fallow rotation, and for irrigated crops.

Three of the soil associations in the county are on high terraces and benches.

12. Bew-Allentine association: Level to sloping, deep soils that have a clay subsoil; on terraces and fans

This association of level to sloping soils is on terraces south of Shepherd and west of Huntley. The intermittent drainageways are tributaries of the Yellowstone River. The native vegetation is mostly grasses, sagebrush, and greasewood.

The elevation is about 3,000 feet. The annual precipitation is 11 to 13 inches, the mean annual temperature is 46 to 48° F., and there are 125 to 130 frost-free days.

This association occupies about 1 percent of the county. It is 60 percent Bew soils and 20 percent Allentine soils. The rest is minor soils.

The major soils are well drained. Bew soils have a grayish-brown silty clay loam surface layer. The subsoil is brownish clay, and the substratum is grayish clay and heavy clay loam. Depth to bedrock is more than 60 inches.

The surface layer and subsoil of Allentine soils are brownish clay, and the substratum is brownish to olive-gray clay. Depth to bedrock is more than 60 inches.

Among the minor soils are Bone and Sage soils on fans and terraces.

Nearly all this association is in irrigated small grains, corn for silage, and hay and pasture. Beef cattle, dairy cattle, and sheep are the main livestock on irrigated farms.

A few pheasants and rabbits are the main wildlife in this association. Ducks feed and nest in the drainage ditches.

13. Wanetta-Keiser association: Level to steep, deep soils that have a clay loam to silty clay subsoil; on high terraces

This association of level to steep soils is on gravel-capped sandstone and shale uplands along the Yellowstone and Bighorn Rivers and east of Pryor Creek. Along the Yellowstone River, the terraces are 150 to 400 feet above the main channel. Between Billings and Huntley, the areas are dissected by deep valleys cut completely through the gravel capping. Shale and sandstone are exposed on the lower sides of these valleys, and gravelly alluvium covers the valley floor. Northwest and south of Custer the landscape is smooth, broken only by deep drainageways at the edge of the Big Horn and Yellowstone River Valleys. The native vegetation is mostly grasses, sagebrush, yucca, skunkbush, and sumac. Ponderosa pine and cedar trees grow in the deep valleys on shale and sandstone outcrops.

Elevation ranges from 3,000 to 3,600 feet. The annual precipitation is 11 to 14 inches. The mean annual temperature is 45 to 47° F., and there are 120 to 130 frost-free days.

This association occupies 7 percent of the county. It is 35 percent Wanetta soils and 30 percent Keiser soils. The rest is Hilly gravelly land and minor soils.

The major soils are well drained. Wanetta soils are on smooth terraces between deep drainageways. The surface layer is grayish-brown clay loam, the subsoil is brownish and grayish clay loam, and the substratum is light brownish-gray gravelly light clay loam. Depth to gravel is 20 to 40 inches.

Keiser soils are on smooth terraces between deep drainageways. The surface layer is grayish-brown silt loam, the subsoil is brownish silty clay loam and silty clay, and the substratum is light-gray silty clay loam to silt loam. Depth to bedrock is more than 60 inches.

Hilly gravelly land is on steep terrace edges along main valleys and on the sides of deep valleys and drainageways that cross the terraces. Among the minor soils are Shorey soils on fans and terraces and Toluca soils on smooth terraces between deep drainageways. Pierre and Lismas soils are below the Hilly gravelly land, and Thurlow and McRae soils are in the widest valleys.

The Wanetta and Keiser soils are used for dryfarmed and irrigated crops and for range. Hilly gravelly land is used only for range and as a source of gravel and sand. The lowest terraces along the Yellowstone River are irrigated. Wheat and barley are dryfarmed in a crop-fallow system. This association has few springs or sites suitable for stock-water ponds. Pumped wells are the most reliable source of water.

The main wildlife is upland game birds. Ducks and geese from the major rivers feed in the grainfields. A few pheasants live in the perennial stream valleys. Antelope live on nearly level terraces, and mule deer from the adjoining river bottoms feed in the brushy draws.

14. Danvers association: Gently undulating to rolling, deep soils that have a silty clay and clay loam subsoil; on high benches and terraces

This association of gently undulating to rolling soils is on high terraces near the headwaters of Arrow and Spring Creeks south of Ballantine and along Pryor Creek. The drainageways are tributaries of the Yellowstone River, Pryor Creek, and Fly Creek. Underlying gravelly sand is exposed at terrace edges and in deep drainageways that cross the terraces. Undissected terraces have a mantle of alluvium 3 to 6 feet thick. The native vegetation is mostly grasses and sagebrush. A few shrubs grow in the deep drainageways.

Elevation ranges from 3,400 to 4,200 feet. The annual precipitation is 14 to 16 inches, the mean annual temperature is 44 to 45° F., and there are 110 to 125 frost-free days.

The association occupies about 4 percent of the county. It is 50 percent Danvers soils, 20 percent Shaak soils, 10 percent Oburn soils, and 20 percent Hilly gravelly land. Small areas of other soils make up the rest of the association.

Danvers soils are well drained. They occur on crests of low mounds, convex slopes, and along deep drainageways. The surface layer is grayish-brown silt loam. The subsoil is brownish silty clay and heavy clay loam. The substratum is white and light-gray light clay loam. The depth to underlying sand and gravel is 48 to 72 inches.

Shaak soils are on flats and concave slopes, and the Oburn soils are in slight depressions and nearly level areas where water collects. Hilly gravelly land is on terrace edges and the sides of deep drainageways that dissect the terraces.

This association is used for range and for wheat and barley dryfarmed in a crop-fallow system. Crop growth is good on all the major soils. Beef cattle graze on crop residues and in the areas of Hilly gravelly land. Seeps and springs in deep drainageways and along terrace edges provide water for livestock.

The wildlife in the association is mostly sage grouse, sharptail grouse, and pheasant. Antelope and deer from surrounding areas feed in the grainfields.

Use and Management of the Soils

The soils of Yellowstone County are used mainly for pasture and range and for irrigated and nonirrigated crops. This section explains how the soils can be managed for these main purposes and also for windbreakers and for

building highways, farm ponds, and other engineering structures. It also gives the predicted yields of principal irrigated and nonirrigated crops. Information on crops is given by describing general practices suitable for all the soils, then grouping the soils that require similar management, describing the group, and suggesting suitable management for the group.

Management of Irrigated Cropland

About 86,364 acres in the county were irrigated in 1964. The main irrigated crops are sugar beets, dry beans, silage corn, small grains, and hay. The most common needs in managing irrigated soils are practices for maintaining fertility, using water efficiently, and controlling erosion.

The soils have a low content of nitrogen and phosphorus. Legumes planted in the cropping system (*7*) and nitrogen and phosphorus fertilizers help correct this deficiency. Mineral fertilizers mainly supplement the natural supply during the year they are applied (*3*). Some phosphorus fertilizer applied one year may be left over for future years, but nitrogen fertilizer generally is not. The residual benefit of fertilizer is reduced if crop response is good or if excess water is applied.

In the Yellowstone River Valley, the cropping system for deep, level, loamy soils is generally sugar beets for 2 to 4 years, silage corn, small grains, or beans for 1 year, and then sugar beets. The cropping system for level clay soils is sugar beets for 2 or 3 years, silage corn or small grains for 1 year, and pasture for 2 or 3 years. Steeper soils generally are used more for pasture and alfalfa.

The irrigation system is chosen to provide optimum control and distribution of water at minimum cost and labor. Overirrigation wastes water, leaches plant nutrients, and erodes the soil. Excess water also creates drainage problems, raises water tables, and increases soil salinity. On steeper soils, the risk of erosion is greater, and as surface soil erodes, subsurface layers that contain large amounts of carbonates or soluble salts may be mixed in the plow layer. This reduces crop yields and increases the cost of management.

Management of Nonirrigated Cropland

About 85,000 acres in Yellowstone County were dryfarmed in 1964. Winter wheat and barley are the major dryfarmed crops. Spring wheat and oats are also grown. The low annual precipitation of 11 to 16 inches makes water conservation the primary concern in managing dryfarmed soils. If 8 to 12 inches of water are available in the soil during the growing season, crops can be expected to grow well.

Most dryfarmed soils have moderate fertility, but nitrogen and phosphorus fertilizer may be needed. Fertility is highest immediately after the soils are plowed out of sod. Burning the stubble temporarily increases crop yields, but is ultimately harmful because it destroys crop residues that restore organic matter to the soil.

The most common cropping system is small grains one year and fallow the next (*5*). Grasses and legumes can be grown on all dryfarmed soils (*2*). Fallow tillage helps to eliminate weeds, store moisture, and control soil blowing (*6*). Tilling is done mostly with sweeps, chisel implements, and rod weeders, implements that leave crop residues on the surface. This helps to control erosion.

Soil blowing and water erosion can be controlled by protecting the surface with stubble mulch, by stripcropping, by planting a cover crop on steep slopes, and by keeping a good stand of grass in pastures. Large fields can be stripcropped, but some fields are too small or too irregular in shape to stripcrop. Soils having 2 to 4 percent slopes may be suited to contour plowing. Stubble mulch tillage is needed on sandy soils, such as Worland fine sandy loam, and a permanent grass cover is needed in large areas of steep, thin, or sandy soils. Grasses should be grown as cover in drainageways to control erosion.

Management of Saline and Alkali Soils

There are about 82,000 acres of saline, saline-sodic, or sodic soils in Yellowstone County. About 6,000 acres are irrigated and 15,000 acres are dryfarmed.

Saline soils contain soluble salts in amounts that impair seed germination and plant growth. These soils do not contain exchangeable sodium. Because the salts flocculate the clayey subsoil, the physical condition and permeability of these soils are generally satisfactory.

Alkali soils contain more than 15 percent exchangeable sodium. They do not contain harmful amounts of salt. The clay in these soils is dispersed, the shrink-swell potential is high, and the permeability to water and air is slow.

Saline-alkali soils contain harmful amounts of soluble salts and more than 15 percent exchangeable sodium. Because the sodium content is high, the soils have poor physical condition and a high shrink-swell potential. The permeability to air and water is generally slow. If the concentration of soluble salts is high, the salts flocculate the soil and offset the effects of sodium.

Soil salinity is caused by salty water that rises from high water tables. High water tables form because the soil has impermeable layers and poor drainage. Seepage from irrigation canals and ditches and overirrigation also may cause high water tables to form.

Soil alkalinity is caused by parent material that contains sodium. Sodium rises to the root zone in ground water. In many places alkali soils have slick spots or pan spots on the surface. In some places, hydrolyzed sodium, or lye, dissolves organic matter, which collects on the surface in the form of a dark crust called black alkali. The adsorbed sodium on the exchange complex of the clays accounts for the poor physical condition and the high shrink-swell potential of alkali soils. These soils are difficult to reclaim because they have slow permeability.

Saline soils are reclaimed by removing salts. This can only be done by leaching with water. Leaching is done by ponding water on the soil or by overirrigation. Good drainage is necessary. In some areas, soluble calcium must be applied to flocculate the soils after the salt is removed.

Alkali or saline-alkali soils are more difficult to reclaim. No single method applies in all cases. Thorough sampling and testing of the soils are necessary to determine what combination of methods to apply. If the sodium is concentrated near the surface in scattered "pan spots," or "slick spots," the soil can be reclaimed by deep plowing or by spreading large amounts of gypsum or sulfur on the spots. Artificial leaching is required if sodium is present

throughout the soil or if sodium occurs in association with a high content of soluble salts.

Salt tolerant crops can be grown on soils in which salinity cannot be entirely eliminated. Crops that are salt tolerant during germination can establish a satisfactory stand. Some crops are salt tolerant during later stages of growth but are quite sensitive to salinity during germination. Highly salt-tolerant crops are barley, sugar beets, and western and tall wheatgrass. Crops that have low salt tolerance are beans and white Dutch, alsike, red, and Ladino clovers. Special planting to minimize salt accumulation around the seed, irrigation to maintain relatively high soil moisture, and water-conveyance and drainage systems may be required on saline soils.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, *or c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the irrigated and dryland capability units in Yellowstone County are described and suggestions for the use and management of the soils are given. To find the unit in which a given soil has been placed, refer to the "Guide to Mapping Units" at the back of this survey.

Management of irrigated soils by capability units

In this subsection, each irrigated capability unit is described and soil characteristics and hazards of management are discussed. Suitable crops and management practices are mentioned.

CAPABILITY UNIT I-1, IRRIGATED

This unit consists mainly of moderately fine textured to moderately coarse textured soils that are more than 60 inches deep. These soils are well drained and nearly level. They occur on flood plains, terraces, and fans. Permeability is moderate, and available water capacity is about 10 inches. Fertility and organic-matter content are moderate. Surface runoff is slow, and the hazard of water erosion is slight. Soil blowing is a hazard on fields left bare in spring and fall. Some areas on the low flood plains of the major rivers are subject to occasional flooding in spring. The frost-free season is about 125 days.

These soils are well suited to sugar beets, small grains, dry beans, corn for silage, canning crops, potatoes, and hay. Barnyard and green manures and commercial fertilizers are required to increase and maintain soil fertility. Barnyard manure is used for sugar beets, corn, and beans. Hay responds well to phosphorus fertilizer after the first year of growth.

Irrigation water can be applied by the gravity system. The border method of irrigation gives the best water distribution for hay, small grains, and pasture. Over-irrigation should be avoided, particularly in places where subsurface drainage outlets are difficult to install. Leveling improves water distribution where the soil surface is uneven. These soils are not permanently damaged by deep cutting, but additional applications of barnyard manure, nitrogen, and phosphorus are beneficial where a sandy loam layer or a limy subsoil is exposed by leveling.

CAPABILITY UNIT IIe-1, IRRIGATED

This unit consists of deep and moderately deep, gently sloping, medium-textured soils on fans and terraces. Permeability is moderate, and the available water capacity is 5 to 9 inches. These soils absorb water easily, and runoff is slow. The hazard of soil blowing is slight to moderate. The frost-free season is 122 to 130 days. The fertility is high.

These soils are suited to sugar beets, dry beans, corn for silage, small grains, alfalfa, and hay and pasture. Good growth of crops depends on use of barnyard and green manure and nitrogen and phosphorus fertilizers. Alfalfa benefits from phosphorus fertilizer after the first year. Soil blowing can be reduced by leaving the surface rough in winter and early in spring and by planting orchardgrass and bromegrass with alfalfa.

All methods of irrigation can be used. The border method distributes water well on close-sown crops. Water erosion can be controlled in fields of row crops by using small streams and short runs. Leveling is needed in some areas to improve water distribution. Cuts made in leveling do not permanently damage these soils.

CAPABILITY UNIT IIs-1, IRRIGATED

This unit consists of well-drained silty clay loams and silty clays that are deep and moderately deep over gravel. These nearly level soils are on stream terraces. They have moderately slow permeability. The available water capacity ranges from 5 to 10 inches. Natural fertility is moderate. Runoff is slow, but soil blowing is a hazard if the granular surface is bare. The frost-free season is about 125 days.

These soils are suited to sugar beets, dry beans, corn for silage, small grains, and hay and pasture. Sugar beets and dry beans require extra care in preparing the seedbed to avoid compacting the soil. Permeability and tilth are improved by growing sod crops, adding barnyard manure, and returning crop residue to the soil. Crops on these soils respond well to nitrogen and phosphorus fertilizers.

If these soils are plowed when they are wet, hard clods form that are difficult to break down into a smooth seedbed. Fall plowing allows winter freezing and thawing to break down the clods into fine granules. Because the dry granular surface blows easily, it should be left rough until planting time.

All methods of irrigation can be used on these soils. The border method gives the best water control and distribution for close-sown crops. In some places leveling is needed to improve water distribution. Cuts made in leveling do not permanently damage these soils.

CAPABILITY UNIT IIs-2, IRRIGATED

This unit consists of deep, nearly level, loamy and clay loam soils on fans and stream terraces. These soils have a massive cultivated surface layer and a slowly permeable subsoil. The available water capacity is about 10 inches. Runoff is slow, and the hazard of water erosion and soil blowing is slight. The frost-free season is about 125 days. The fertility is moderate.

These soils are suited to corn for silage, to small grains, and to hay and pasture. Soil tilth and permeability can be improved by planting grass and legume crops at least half the time and by using green manure and barnyard manure. Nitrogen and phosphorus fertilizers are beneficial.

All methods of irrigation can be used. Leveling improves water distribution but temporarily reduces crop growth because it exposes saline or strongly alkaline soil layers.

CAPABILITY UNIT IIs-3, IRRIGATED

This unit consists of moderately deep, nearly level, well-drained, medium-textured to moderately fine textured soils on stream terraces. These soils are underlain by gravelly sand. Permeability is moderate, and the available water capacity is 5 to 7 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. The frost-free season is 125 to 130 days. The fertility is moderate.

These soils are suited to sugar beets, dry beans, small grains, corn for silage, and hay and pasture. Crops respond well to green and barnyard manure and to nitrogen and phosphorus fertilizers. Soil blowing can be controlled by plowing in spring and leaving the soil rough in winter.

All methods of irrigation can be used. The border method distributes water well on close-sown crops. Leaching of plant nutrients from these soils can be reduced by light, frequent irrigation. The soils can be leveled without permanent damage, provided the cuts do not expose the underlying sand and gravel.

CAPABILITY UNIT IIw-1, IRRIGATED

Lohmiller soils, seeped, 0 to 2 percent slopes, are the only soils in this unit. These soils occur on stream terraces and are deep, are nearly level, and have moderately slow permeability. These soils contain salts and have a water table within 3 feet of the surface during part of the growing season. The natural fertility is moderate. The available water capacity is 10 inches. The frost-free season is about 125 days.

Excess salts and wetness limit the choice of crops in undrained areas. Installing a system of open or closed drains to lower the water table is the first step in reclaiming these soils. Following drainage, the excess salts can be removed by leaching with irrigation water.

During the reclamation period, sugar beets, small grains, barley, pasture plants, and other salt-tolerant crops can be grown. After these soils are reclaimed, corn, small grains, and alfalfa also can be grown. Barnyard

manure and crop residues mixed into the plow layer increase permeability and reduce the toxic effect of the salts. Nitrogen and phosphorus fertilizers are beneficial. Pasture and hay benefit from commercial fertilizers after the first year. Where these soils are not reclaimed, alta fescue or tall wheatgrass can be seeded.

Irrigation water should be applied generously while these soils are being reclaimed. The border method gives the best water control. Where needed, leveling improves water distribution.

CAPABILITY UNIT IIIe-1, IRRIGATED

This unit consists of deep, gently sloping, well-drained silty clay and clay soils on fans and terraces. Permeability is slow, and the available water capacity is about 10 inches. Runoff is slow. The hazard of soil blowing is moderate. The frost-free season is 120 to 130 days. The fertility is moderate.

These soils are suited to small grains, to corn for silage, and to hay and pasture. Sugar beets can be grown, but they require frequent light irrigation.

These soils are hard to plow and work into a good seedbed, and the cost of power to cultivate them is high. Large clods form on plowed soil. The clods break down into granules after repeated wetting and drying. To control soil blowing, these soils are plowed in fall and left rough in winter. Corn and grass respond well to nitrogen fertilizer, and phosphorus fertilizer benefits alfalfa after the first year. Green manure and barnyard manure applied to row crops improve permeability and soil tilth.

All methods of irrigation can be used. The border method distributes water well on close-sown crops. On the more sloping soils, short runs and small streams are required to control water erosion. Leveling is needed to improve water distribution in some places. Cuts made in leveling do not permanently damage these soils.

CAPABILITY UNIT IIIe-2, IRRIGATED

This unit consists of deep, gently sloping to strongly sloping, well-drained, moderately coarse textured to moderately fine textured soils on fans, terraces, and valley sides. Permeability is moderate, and the available water capacity is 7 to 9 inches. Runoff is medium, and the hazard of erosion from irrigation water is high. The hazard of soil blowing is moderate. The frost-free season is 125 to 130 days. The fertility is moderate.

These soils are suited to small grains and to hay and pasture. Crops respond well to nitrogen and phosphorus fertilizers. Barnyard manure and crop residues help to maintain the organic-matter content. Soil blowing can be reduced by leaving the soil rough in winter and by plowing in spring. Row crops are planted on the contour to reduce water erosion.

Corrugations, contour ditches, and sprinklers can be used to apply irrigation water. Seepage from irrigated valley sides into lower lying soils occurs if water distribution is not carefully controlled. Shaping and leveling to improve distribution do not permanently damage these soils.

CAPABILITY UNIT IIIs-1, IRRIGATED

This unit consists of nearly level, well-drained, clayey soils on stream terraces. Permeability and runoff are slow, and the available water capacity is about 10 inches. The hazard of soil blowing is moderate to severe. The frost-free season is about 125 days. The fertility is moderate.

These soils are suited to small grains, corn for silage, hay, and pasture. They are less well suited to sugar beets (fig. 3) and dry beans.

The cost of power to cultivate these soils is high. Field machines puddle wet soils, and dry soils are cloddy. Fall plowing allows frost action and alternate wetting and drying to break down clods in winter. Tilth and permeability can be improved by heavy applications of green and barnyard manure and by leaving crop residues on the surface. Soil blowing can be controlled by leaving the soil rough until planting. Limiting row crops to no more than 2 consecutive years helps to maintain soil structure. Crops respond well to nitrogen and phosphorus fertilizer.

All methods of irrigation can be used. The border method is good for close-sown crops. Fields must be leveled to insure uniform water distribution, but cuts made in leveling do not permanently damage these soils.

CAPABILITY UNIT IIIs-2, IRRIGATED

This unit consists of shallow, nearly level to gently sloping, loamy soils on stream terraces and bottom lands. These soils are underlain by gravel and are well drained. Permeability is moderate, and the available water capacity is 3 to 5 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. The frost-free season is 125 to 130 days. The fertility is moderate to low.

These soils are suited to small grains and hay. They require frequent irrigation during dry periods. Soil tilth can be improved by using green and barnyard manure and by growing grass and legumes at least half of the time.

Contour ditches are used to irrigate these shallow soils. Cuts made in leveling expose the gravel substratum in some places.

CAPABILITY UNIT IVe-1, IRRIGATED

This unit consists of shallow, gently sloping to moderately sloping, gravelly loam and clay loam soils on terraces. These soils are underlain by gravel and sand. The available water capacity is 2 to 3 inches. Slopes are short and uneven, runoff is medium, and the hazard of water erosion is moderate. The frost-free season is about 125 days. The fertility is moderate.

These soils are suited to hay and pasture and small grains. A suitable mixture is smooth brome, orchardgrass, and alfalfa. Small grains are grown only when it is necessary to reestablish hay and pasture crops. Barnyard manure and nitrogen and phosphorus fertilizers are beneficial. Hay and pasture crops respond to phosphorus fertilizer after the first year. Gravel in the surface layer interferes with cultivation in some areas, and row crops are difficult to grow because slopes are uneven.

Corrugations, contour ditches, and sprinklers are used to distribute irrigation water. Light, frequent irrigation prevents leaching and erosion. Overirrigation causes seepage into surrounding soils.

CAPABILITY UNIT IVs-1, IRRIGATED

Vananda silty clay, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, nearly level, alkali soil on stream terraces. Permeability is very slow, and the avail-

Figure 3.—**Harvesting sugar beets on Bew clay in the Yellowstone River Valley. Capability unit IIIs–1, irrigated.**

able water capacity is about 10 inches. The fertility is moderate.

The crops grown on this soil are sugar beets, corn for silage, small grains, and alfalfa, but the soil is better suited to hay or pasture. Row crops should be grown only occasionally. The choice of crops is limited by the alkalinity.

This soil is hard to plow and work into a good seedbed. A thin, hard, surface crust that has wide cracks forms as the soil drys. The seedbed can be improved and crusting can be reduced by leaving crop residues on the surface. This soil is usually plowed in fall. Crops respond to barnyard manure and nitrogen and phosphorus fertilizer.

The border method of irrigation distributes water well. Leveling is needed to insure uniform water distribution. Deep leveling does not permanently damage this soil, but it may expose the strongly alkaline subsoil.

CAPABILITY UNIT IVs–2, IRRIGATED

This unit consists of nearly level to gently sloping, well-drained to moderately well drained loam and clay loam soils on stream terraces and fans. These soils are very saline and alkaline. Permeability is generally slow, but it is moderate where salts are concentrated in the surface layer. The available water capacity is 7 to 9 inches. Runoff is slow, and the hazard of water erosion and soil blowing is slight. The fertility is moderate. The frost-free season is 120 to 130 days.

These soils are suited to tall wheatgrass, meadow foxtail, and alta fescue grown for hay and pasture. Where salts are concentrated at the surface, only salt-tolerant annual weeds or tall wheatgrass can be grown. In these areas a water table is commonly at a depth of 36 to 60 inches. Small grains are grown only when it is necessary to reestablish grass crops. The choice of crops is limited by the content of sodium and salts, and crops grow unevenly.

The soils in this unit are difficult to cultivate. These soils are hard and cloddy. They slake and puddle when wet, and a hard crust forms as they dry. The crust makes it difficult for plants to emerge after sprouting. The seedbed can be improved and crusting can be reduced by mixing barnyard manure and crop residues into the plow layer.

The border method of irrigation is well suited. Soil can be reclaimed if salts are leached by excess water applied in level borders. Soils that have gypsum salts in the surface layer can be reclaimed by deep plowing.

CAPABILITY UNIT IVw–1, IRRIGATED

This unit consists of moderately well drained loam and clay loam soils and poorly drained, saline loam and silty clay loam soils. These soils are deep and nearly level. Permeability is slow, and the available water capacity is 7 to 9 inches. Runoff is moderate, and the hazard of water erosion and soil blowing is slight. The fertility is moderate. The frost-free season is 120 to 129 days.

These soils are used for hay and pasture. Small grains normally are grown only to reestablish hay or pasture crops.

The soils in this unit are difficult to cultivate. Thev puddle easily, and a hard crust forms on the moderately well drained soils as they dry. The high salt content of the

poorly drained soils limits the choice of crops. Tilth can be improved by applying barnyard and green manure and by installing drains.

These soils are irrigated by the border method. They can be reclaimed if level borders are used to apply excess water to leach the salts. Drains are required where level borders are used.

Management of dryland soils by capability units

In this subsection, each dryland capability unit is described and soil characteristics and hazards of management are discussed. Suitable crops and management practices are mentioned.

CAPABILITY UNIT IIe-2, DRYLAND

This unit consists of level to gently sloping, well-drained, medium-textured and moderately fine textured soils on terraces, fans, and uplands. These soils are 30 to more than 60 inches deep. Permeability is moderate to moderately slow, and the available water capacity is 7 to 10 inches. Runoff is slow, and the hazard of water erosion and soil blowing is slight. The annual precipitation is 14 to 16 inches, and the frost-free season is 110 to 125 days. The fertility is high.

These soils are suited to wheat and barley dryfarmed in a crop-fallow system. Alfalfa, safflower, and corn for silage also can be grown. Native grasses grow well. Nitrogen fertilizer is beneficial if the amount of available water is above average in spring. Phosphorus fertilizer benefits alfalfa the second year after seeding. Crop stubble left on the soil surface helps to hold snow cover and to increase water intake when rains are heavy.

CAPABILITY UNIT IIs-4, DRYLAND

This unit consists of deep, level to gently sloping, well-drained soils that have a loamy or clayey surface layer. The subsoil is slowly permeable clay. These soils occur on high stream terraces. They have moderate to high natural fertility and organic-matter content. The available water capacity is about 10 inches. Runoff is slow, and the risk of water erosion and soil blowing is slight. The annual precipitation is 14 to 16 inches, and the frost-free season ranges from 110 to 125 days.

These soils are suited to wheat and barley dryfarmed in a crop-fallow system. Grasses and legumes grown in the rotation help maintain organic-matter content, improve tilth, and increase permeability of the subsoil. Crops respond to phosphorus and nitrogen fertilizers if the soils are moist to a depth of more than 30 inches at seeding time. Crop residues left on the surface help to hold snow cover. The power costs increase when tillage is into the clay subsoil.

CAPABILITY UNIT IIIe-3, DRYLAND

This unit consists of well-drained, slowly permeable silty clay and clay soils that have slopes of 1 to 4 percent. These soils occur on fans, valley sides, and stream terraces. The natural fertility and the permeability are moderate. Water erosion is a slight to moderate hazard. The available water capacity is about 10 inches. On the stronger slopes, loss of soil normally is caused by rill erosion. Soil blowing is a hazard in bare areas. The annual precipitation is 11 to 13 inches, and the frost-free season ranges from 115 to 130 days.

These soils are suited to dryfarming, but the costs for power to cultivate them is high. Wheat and barley are grown in a crop-fallow system. Crested wheatgrass, Siberian wheatgrass, and western wheatgrass are grown for pasture and hay.

Stripcropping, contour tillage, and leaving crop residues on the surface help to control water erosion and soil blowing. The surface should be left rough in winter to reduce soil blowing. If these soils are plowed when wet, clods form that break down after repeated drying and wetting or through frost action. The soils on long valley sides need diversion terraces to control runoff from soils that lie above them. Nitrogen and phosphorus fertilizers are beneficial if the soils are moist to a depth of more than 30 inches at seeding time.

CAPABILITY UNIT IIIe-4, DRYLAND

This unit consists of sloping, deep to moderately deep, loamy soils on high terraces, valley sides, and uplands. The surface soil is medium textured, and the subsoil is medium textured to moderately fine textured. These soils are underlain by shale. Permeability is moderate. The available water capacity is 6 inches in the moderately deep soils and 10 inches in the deep soils. The hazard of water erosion is moderate. Annual precipitation is 14 to 15 inches, and the frost-free season is 110 to 120 days. The fertility is high.

These soils are suited to small grains dryfarmed in a crop-fallow system. Crested wheatgrass, intermediate wheatgrass, and alfalfa are grown for hay and pasture. Crops respond to nitrogen and phosphorus fertilizers if these soils are moist to a depth of 36 inches or more at seeding time. Water erosion and soil blowing can be controlled by contour or field stripcropping and by leaving crop residues on the soil surface. On long, steep, valley sides, diversion terraces are needed to control erosion.

CAPABILITY UNIT IIIe-5, DRYLAND

This unit consists of deep and moderately deep, gently sloping to moderately sloping soils on fans, valley sides, and uplands. The surface soil is medium textured, and the subsoil is medium textured to moderately fine textured. Pebbles are on the surface in some areas. Permeability is moderate to moderately slow, and the available water capacity is 5 to 10 inches. Runoff is medium on slopes of more than 3 percent. The hazard of water erosion and soil blowing is moderate. The annual precipitation is 11 to 13 inches, and the frost-free season is 120 to 130 days. The fertility is moderate.

These soils are suited to small grains dryfarmed in a crop-fallow system. Siberian, crested, and pubescent wheatgrasses are grown for hay and pasture. Nitrogen and phosphorus fertilizers are beneficial if annual precipitation is above average. Returning crop residues to the soil maintains organic matter content, improves soil tilth, and reduces erosion.

Water erosion and soil blowing can be controlled by field or contour stripcropping and by leaving crop residues on the surface. Diversion terraces may be needed on valley sides to intercept runoff. The main watercourses should be permanently sodded.

CAPABILITY UNIT IIIe-6, DRYLAND

Yegen sandy loams are the only soils in this unit. These soils occur on terraces and fans. They are deep, are well drained, and have a sandy clay subsoil. Slopes range from 0 to 10 percent. Permeability is moderately slow, and the available water capacity is about 8 inches. Surface runoff is slow to medium, and the hazards of water erosion and soil blowing are moderate. The annual precipitation is 14 to 15 inches, and the frost-free season is about 125 days. The fertility is moderately high.

These soils are suited to wheat and barley dryfarmed in a crop-fallow system. Alfalfa and crested, Siberian, and pubescent wheatgrasses are grown for hay and pasture.

The rapid loss of organic matter in cultivated fields can be reduced by planting grasses and legumes in the cropping system and by returning all crop residues to the soil. Soil blowing and water erosion can be reduced by field or contour stripcropping in narrow strips, planting trees in windbreaks, and leaving crop stubble on the surface. Large waterways should be sodded. On long slopes and valley sides, the soils may need diversion terraces to intercept runoff from soils that lie above them.

CAPABILITY UNIT IIIe-7, DRYLAND

This unit consists of deep soils on fans, valley sides, and terraces, and soils that are on uplands and are moderately deep over sandstone. These soils are gently sloping to sloping. The surface soil is fine sandy loam, and the subsoil is sandy clay. Permeability is moderately rapid, and the available water capacity is 4 to 7 inches. Runoff generally is slow, but water erosion is likely on the steeper valley slopes that receive runoff from soils above them. These soils are also susceptible to soil blowing. The annual precipitation is 11 to 14 inches, and the frost-free season is about 125 days. The fertility is moderate.

These soils are suited to small grains dryfarmed in a crop-fallow system. Alfalfa and crested, Siberian, and pubescent wheatgrasses are grown for hay and pasture.

Soil blowing can be reduced by cropping in narrow strips, planting trees in windbreaks, and leaving crop residues on the surface. The organic-matter content can be maintained by returning all crop residues to the soil. Crops respond to nitrogen fertilizer if the soil is moist to a depth of 36 inches or more at seeding time. Diversion terraces may be needed on valley slopes to intercept runoff.

CAPABILITY UNIT IIIs-3, DRYLAND

The unit consists of deep, nearly level, well-drained clayey soils, and complexes of deep, well-drained loamy soils and saline-alkali clayey soils. These soils occur on terraces, fans, and dry lake basins. They are slowly permeable to water, air, and plant roots. The available water capacity is 10 to 12 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. The annual precipitation is about 13 inches, and the frost-free season is 115 to 130 days. The fertility is moderate.

These soils are suited to small grains dryfarmed in a crop-fallow system. Siberian, crested, and western wheatgrasses are grown for hay and pasture.

The cost of power to cultivate these soils is high. The surface layer becomes cloddy if tilled when wet. Tilth and permeability can be improved by returning all crop residues to the soil. Soil blowing can be reduced by leaving crop residues on the surface.

CAPABILITY UNIT IIIc-1, DRYLAND

This unit consists of deep, nearly level, well-drained, medium-textured to moderately fine textured soils on stream terraces, fans, and shale uplands. Permeability is moderate, and the available water capacity is about 8 inches. These soils absorb water readily, and runoff is slow. The hazard of soil blowing is slight to moderate. The annual precipitation is 11 to 14 inches, and the frost-free season is about 125 days. The organic-matter content is medium, and the fertility is moderate.

These soils are suited to small grains dryfarmed in a crop-fallow system. Crested wheatgrass and Siberian wheatgrass are grown for hay and pasture. Crop growth depends on the amount of water available.

Nitrogen and phosphorus fertilizers benefit small grains where soils receive runoff from surrounding areas or where the soil is moist to a depth of more than 36 inches in fall and early in spring. The organic-matter content can be maintained and soil blowing can be reduced by leaving crop residues on the soil surface.

CAPABILITY UNIT IVe-2, DRYLAND

This unit consists of moderately deep sandy soils on fans and soils that occur on uplands and are moderately deep over sandstone. These soils are gently sloping to sloping. Permeability is moderately rapid, and the available water capacity is 3 to 5 inches. These soils absorb water readily and have slow runoff. They are highly susceptible to soil blowing. The annual precipitation is 11 to 13 inches, and the frost-free season is about 125 days. The organic-matter content is low, and the fertility is moderate.

These soils are suited to small grains dryfarmed in a crop-fallow system. Crested wheatgrass and Siberian wheatgrass are grown for hay and pasture.

Soil blowing can be controlled by cropping in narrow strips, planting trees in windbreaks, and leaving crop residues on the soil surface. Emergency tillage to roughen the soil surface may be necessary when soil blowing is severe. The loss of organic matter can be reduced by returning all crop residues to the soil and by keeping tillage to a minimum. Nitrogen fertilizer is beneficial.

CAPABILITY UNIT IVe-3, DRYLAND

This unit consists of deep, strongly sloping, well-drained, medium-textured soils on the edges of gravelly terraces and eroded fans. Permeability is moderate, and the available water capacity is 7 to 9 inches. Runoff is rapid, and the hazard of water erosion is moderate to severe. Sheet and rill erosion occur early in spring when runoff water from melting snow flows over soils that have a frozen subsoil. The annual precipitation is 14 to 16 inches, and the frost-free season is about 125 days. The organic-matter content is medium to high, and the fertility is high.

Suitable for hay and pasture are crested, Siberian, and western wheatgrasses. Alfalfa can be grown for hay and seed.

Erosion can be controlled by contour stripcropping and by leaving crop residues on the surface.

CAPABILITY UNIT IVe-4, DRYLAND

This unit consists of deep, strongly sloping soils on terraces, fans, and valley sides and moderately sloping soils that occur on uplands and are moderately deep over soft shale. These soils are medium textured. Permeability is moderate, and the available water capacity is 3 to 9 inches. Runoff is medium, and the hazard of water erosion is moderate to high. The hazard of soil blowing is moderate to low. Annual precipitation is 12 to 14 inches, and the frost-free season is about 125 days. The organic matter content is low, and the fertility is moderate.

These soils are suited to small grains dryfarmed in a crop-fallow system. Grass seedings in eroded areas benefit from light applications of nitrogen fertilizer. Erosion can be reduced by contour stripcropping, by planting permanent grass buffers, and by leaving crop residues on the surface.

CAPABILITY UNIT IVe-5, DRYLAND

This unit consists of deep soils on fans and soils that occur on uplands and are moderately deep over shale. These soils are moderately sloping and clayey. Permeability is slow, and the available water capacity is 7 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate. The bare, granular surface layer is highly susceptible to soil blowing. The annual precipitation is about 12 inches, and the frost-free season is about 125 days. The fertility is moderate.

These soils are suited to small grains dryfarmed in a crop-fallow system. Siberian, crested, and western wheatgrasses are grown for hay and pasture.

Water erosion and soil blowing can be reduced by stripcropping or contour stripcropping, by using tillage implements that leave the soil surface rough, and by leaving crop residues on the surface.

CAPABILITY UNIT Vw-1, DRYLAND

Only Alluvial land, seeped, and Alluvial land, wet, are in this unit. These land types consist of poorly drained, loamy and clayey alluvium on terraces and fans. They are 36 to more than 60 inches deep. A permanent water table is within 36 inches of the surface and small spots of open water occur in some areas.

The soils in this unit are suited to range. Birds use the plant cover for roosting, for nesting, and as escape lanes. Wildlife cover is reduced if plants of low quality are burned.

CAPABILITY UNIT VIe-1, DRYLAND

This unit consists of deep, moderately steep loamy soils on terrace edges and the sides of deep drainageways and of gently sloping to strongly sloping loamy soils that occur on uplands and are moderately deep and shallow over sandstone. The soils in valleys have a high available water capacity, but most precipitation is lost through surface runoff. Soils on uplands have a low available water capacity. The hazard of water erosion is severe, and the hazard of soil blowing is moderate. The annual precipitation is about 13 inches, and the frost-free season is 125 to 130 days. The organic-matter content is low to medium, and the fertility is moderate to low.

These soils are suited to range.

CAPABILITY UNIT VIe-2, DRYLAND

Apron Travessilla loamy fine sands, 7 to 15 percent slopes, are the only soils in this unit. They occur on uplands, are somewhat excessively drained, and are deep over soft sandstone. Permeability is rapid, and the available water capacity is 2 to 6 inches. Runoff is slow. Bare soils are susceptible to soil blowing. Annual precipitation is 12 to 13 inches, and the frost-free season is about 125 days. The fertility is moderate.

These soils are suited to range.

CAPABILITY UNIT VIe-3, DRYLAND

This unit consists of well-drained to somewhat excessively drained, sandy loam and loam soils on plateaus and eroded uplands. These soils are gently sloping to moderately steep and are shallow over hard shale and sandstone or gravelly sand. Permeability is moderate to moderately rapid, and the available water capacity is 2 to 4 inches. These soils absorb water easily, and runoff is slow. The hazard of soil blowing is moderate to high. The annual precipitation is 11 to 14 inches, and the frost-free season is about 125 days. The fertility is moderate to low.

These soils are suited to range.

CAPABILITY UNIT VIe-4, DRYLAND

This unit consists of soils that occur on uplands and valley sides. These soils are sloping to steep, medium textured to moderately fine textured, and shallow to deep over shale. Permeability is moderate, and the available water capacity is 3 to 8 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to severe. The hazard of soil blowing is moderate to low. The annual precipitation is 11 to 14 inches, and the frost-free season is about 125 days. The fertility is moderate to low.

These soils are suited to range. Crested wheatgrass and Siberian wheatgrass are grown on sloping soils. New seedings require protection from soil blowing.

CAPABILITY UNIT VIw-1, DRYLAND

This unit consists of deep, somewhat poorly drained, saline soils and moderately well drained, alkali soils. These soils are level to gently sloping. They occur on fans and terraces. The annual precipitation is about 13 inches, and the available water capacity is about 9 inches.

These soils are suited to range.

CAPABILITY UNIT VIw-2, DRYLAND

This unit consists of deep, silty clay loam soils on stream-dissected terraces, and of clay soils in shallow depressions on uplands. These soils are level to gently sloping. Permeability is moderate to very slow, and the available water capacity is about 9 inches. Flooding and ponding are moderate hazards. The annual precipitation is about 13 inches, and the frost-free season is about 125 days. The fertility is moderate.

These soils are suited to range.

CAPABILITY UNIT VIs-1, DRYLAND

This unit consists of deep, strongly alkaline, clay, clay loam, and silty loam soils. The soils have slow permeability, high alkalinity, and poor tilth. They are suited to range.

CAPABILITY UNIT VIIs-1, DRYLAND

This unit consists of very shallow, channery clay loam soils and steep rock outcrop on the rims and sides of deep valleys of shale uplands. Permeability is moderate, and the available water capacity is 1 to 3 inches. Runoff is rapid, and the hazard of water erosion is high.

These soils are suited to range.

CAPABILITY UNIT VIIs-2, DRYLAND

This unit consists of deep, nearly level to sloping, moderately well drained, fine-textured, alkali soils on terraces and fans. Permeability is slow, and the available water capacity is about 10 inches. Runoff is slow to medium. The hazard of water erosion is moderate on the sloping soils. The soils in irrigated valleys have a water table within 5 or 6 feet of the surface. The fertility is moderate.

These soils are suited to range.

CAPABILITY UNIT VIIs-3, DRYLAND

This unit consists of clay loam and Shale outcrop. The soil occurs on uplands and is underlain by clay shale. It is shallow and steep, the permeability is slow, and the available water capacity is 2 to 4 inches. Runoff is rapid, and the hazards of water erosion and soil blowing are moderate to high. The annual precipitation is 13 to 14 inches, and the fertility is moderate.

This unit is suited to range.

CAPABILITY UNIT VIIIw-2, DRYLAND

Sage clay, 0 to 1 percent slopes, is the only soil in this unit. This soil is barren or nearly barren, wet, and salt crusted. The spotty vegetation consists of highly salt tolerant plants of no forage value.

CAPABILITY UNIT VIIIs-1, DRYLAND

This unit consists of Riverwash and Rock land (fig. 4). This is wasteland that provides refuge for wildlife.

Figure 4.—Rock land, locally called rimrocks, forms the valley rim near Billings. Capability unit VIIIs-1.

Predicted Yields of Irrigated Crops [2]

In table 1 are listed the predicted yields per acre of the principal irrigated crops grown in the county. The yield figures are averages of yields over long periods under two levels of management. Information obtained from individual farmers, from the Huntley Experiment Station, and from farm field trials was used. The yields in columns A are for average management, and those in columns B are for improved management. The management for each crop is discussed in the following paragraphs.

For sugar beets, average management consists of applying 60 pounds of nitrogen fertilizer, 80 pounds of phosphorus fertilizer, and 5 to 10 tons of barnyard manure per acre, plowing in fall, seeding at random dates, and irrigating late in the growing season. Improved management consists of applying 100 pounds of nitrogen fertilizer, 125 pounds of phosphorus fertilizer, and 10 to 15 tons of barnyard manure per acre, plowing in fall, preparing the seedbed by harrowing, floating, or packing, seeding no later than April 15 and as early as possible after the last killing frost, and irrigating early to insure that seedlings have ample moisture.

For dry beans, average management consists of planting at random in the rotation, applying 20 pounds of nitrogen and 40 pounds of phosphorus fertilizer per acre, but no manure, irrigating at random times and sometimes too heavily, and harvesting at random times. Improved management consists of planting in strict rotation and never after a sod crop, preparing a firm smooth seedbed, applying 60 pounds of nitrogen and 100 pounds of phosphorus fertilizer per acre, applying barnyard manure, irrigating frequently, and harvesting in time to prevent shattering.

[2] ROBERT BUCHER, Yellowstone County extension agent, helped prepare this section.

TABLE 1.—*Predicted average acre yields of principal irrigated crops under average and improved management*

[In columns A are yields under average management, and in columns B are yields that could be obtained under improved management. Absence of yield indicates soil is not suited to the crop. If a soil is not listed in this table, it is considered not suitable for irrigated crops]

Soil	Sugar beets		Dry beans		Silage corn		Alfalfa hay		Wheat		Barley	
	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Arvada clay loam, 0 to 1 percent slope	6	12					1.0	2.5	10	20	15	25
Arvada clay loam, 1 to 4 percent slopes	6	12					1.0	2.5	10	20	15	25
Bew silty clay loam, 0 to 1 percent slopes	17	22	18	22	19	27	4.5	6.0	41	65	60	95
Bew clay, 0 to 1 percent slopes	11	15	13	19	16	22	3.5	5.0	35	53	48	68
Bew clay, 1 to 4 percent slopes	10	13	10	16	14	18	3.5	4.5	33	50	44	61
Bew-Allentine clays, 0 to 1 percent slopes	11	15	13	19	16	22	3.5	4.5	35	53	48	68
Fort Collins-Arvada clay loams, 0 to 1 percent slopes	15	18	14	21	16	22	3.5	4.5	35	48	55	75
Fort Collins-Arvada clay loams, 1 to 4 percent slopes	13	16	12	19	14	20	3.5	4.5	31	43	50	70
Fort Collins and Thurlow clay loams, 0 to 1 percent slopes	18	22	23	29	17	27	4.0	5.5	44	65	60	95
Fort Collins and Thurlow clay loams, 1 to 4 percent slopes	16	20	21	26	17	26	4.0	5.5	44	62	58	90
Glenberg fine sandy loam, 1 to 4 percent slopes	16	19	18	21	16	23	4.0	5.0	40	50	62	83
Glenberg loam, 0 to 1 percent slopes	17	21	18	23	16	25	4.0	5.5	45	55	68	90
Glenberg loam, gravelly substratum, 0 to 1 percent slopes	14	18	19	24	15	22	3.5	4.5	38	49	54	74
Grail clay loam, 2 to 4 percent slopes							3.0	4.5	38	58	55	90
Grail silty clay, 0 to 1 percent slopes							3.0	5.0	45	60	60	85
Haverson loam, 0 to 1 percent slopes	19	22	18	25	18	27	4.5	6.0	50	65	60	95

TABLE 1.—*Predicted average acre yields of principal irrigated crops under average and improved management*—Continued

Soil	Sugar beets		Dry beans		Silage corn		Alfalfa hay		Wheat		Barley	
	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Haverson loam, clay substratum, 0 to 1 percent slopes	18	22	18	25	16	25	4.0	5.5	50	65	60	95
Haverson clay loam, 0 to 1 percent slopes							3.5	5.5	45	60	60	85
Haverson silty clay loam, 0 to 1 percent slopes	17	20	19	26	17	27	4.0	6.0	44	60	64	95
Haverson silty clay loam, 1 to 3 percent slopes	16	19	16	21	16	25	4.0	6.0	40	56	61	86
Haverson-Hysham loams, 0 to 1 percent slopes	10	15			6	12	2.0	4.0	25	35	30	50
Haverson loam, gravelly variant, 0 to 1 percent slopes	17	20	17	23	16	23	3.5	4.5	41	52	60	77
Hesper silty clay loam, 0 to 1 percent slopes	18	22	22	28	19	28	4.5	6.0	48	58	57	94
Hesper silty clay loam, 1 to 4 percent slopes	17	21	21	27	19	26	4.5	6.0	45	55	56	92
Hydro-Arvada clay loams, 0 to 2 percent slopes							3.0	4.5	30	46	45	65
Hysham-Laurel loams, 0 to 2 percent slopes							1.0	2.0	10	20	20	35
Hysham-Laurel silty clay loams, 0 to 2 percent slopes							1.0	2.0	10	20	15	25
Keiser silty clay loam, 0 to 1 percent slopes	18	21	22	28	19	28	4.5	6.0	48	58	57	95
Keiser silty clay loam, 1 to 4 percent slopes	16	20	21	26	18	26	4.5	6.0	45	55	58	88
Keiser silty clay loam, 4 to 7 percent slopes					17	24	4.0	5.0	42	50	53	81
Keiser and Hesper silty clay loams, 0 to 1 percent slopes	18	22	22	28	19	28	4.5	6.0	48	58	57	94
Kyle silty clay, 0 to 1 percent slopes	12	14	14	17	21	25	3.5	5.0	40	52	55	75
Kyle silty clay, 1 to 4 percent slopes	13	16	17	21	16	22	4.0	6.0	36	57	53	80
Lambert silt loam, 1 to 4 percent slopes	16	19	19	24	17	25	4.0	5.5	42	52	55	82
Lambert silt loam, 4 to 7 percent slopes							3.0	4.5	30	49	50	75
Larim loam, 0 to 4 percent slopes							2.5	3.5	26	38	31	45
Larim gravelly loam, 0 to 4 percent slopes							1.5	3.0	15	24	20	34
Larim gravelly loam, 4 to 7 percent slopes							1.5	2.5	13	21	18	30
Lohmiller silty clay loam, 3 to 7 percent slopes					16	23	3.5	4.5	38	52	57	80
Lohmiller silty clay, 0 to 1 percent slopes	15	18	21	25	17	27	4.0	6.0	40	60	60	86
Lohmiller soils, seeped, 0 to 2 percent slopes	8	12	8	13	10	15			22	34	26	40
Lohmiller-Hysham silty clay loams, 0 to 1 percent slopes	10	15			9	15	2.0	4.0	23	38	33	49
Lohmiller silty clay, gravelly variant, 0 to 1 percent slopes	15	18	15	21	16	23	3.5	4.5	38	52	57	80
McRae loam, 0 to 1 percent slopes	19	22	23	28	19	28	4.5	6.0	48	58	56	95
McRae loam, 1 to 4 percent slopes	17	20	21	25	19	28	4.5	6.0	48	58	56	90
McRae loam, 4 to 7 percent slopes					16	23	4.0	5.0	41	49	50	77

TABLE 1.—*Predicted average acre yields of principal irrigated crops under average and improved management*—Continued

Soil	Sugar beets		Dry beans		Silage corn		Alfalfa hay		Wheat		Barley	
	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
McRae-Hysham loams, 0 to 1 percent slopes	10	15			9	15	2.0	4.0	25	35	30	50
McRae-Hysham loams, 1 to 3 percent slopes	8	13			4	8	1.5	3.0	15	25	20	35
McRae Hysham-loams, 3 to 6 percent slopes							1.5	3.0	15	25	20	35
Shorey gravelly loam, 1 to 4 percent slopes	12	15	16	19	17	22	3.5	4.5	38	45	50	77
Shorey gravelly loam, 4 to 7 percent slopes							3.0	4.0	35	41	45	70
Thurlow clay loam, 0 to 1 percent slopes	18	22	23	29	17	27	4.0	6.0	44	65	60	95
Thurlow clay loam, 4 to 7 percent slopes							3.5	5.0	35	45	45	62
Toluca clay loam, 0 to 1 percent slopes	16	20	21	27	18	26	4.0	5.5	45	55	54	90
Toluca clay loam, 1 to 4 percent slopes	15	19	20	25	17	24	4.0	5.0	43	52	55	85
Toluca clay loam, 4 to 7 percent slopes							4.0	5.0	40	49	50	77
Toluca and Wanetta clay loams, 0 to 2 percent slopes	17	21	20	26	19	26	4.5	5.5	46	56	55	90
Toluca and Wanetta clay loams, 2 to 4 percent slopes	16	19	20	25	16	24	4.0	5.0	43	52	56	84
Treasure fine sandy loam, 1 to 4 percent slopes	16	19	18	21	16	23	4.0	5.0	40	50	62	80
Treasure fine sandy loam, 4 to 10 percent slopes							3.0	4.5	34	43	45	60
Vananda silty clay, 0 to 1 percent slopes	8	12			6	10	3.0	4.0	20	30	25	40
Wanetta loam, 0 to 1 percent slopes	18	22	23	29	18	28	4.0	6.0	45	60	54	86
Wanetta loam, 1 to 4 percent slopes	16	20	22	26	16	24	4.0	5.5	40	56	55	86
Wanetta gravelly loam, 0 to 2 percent slopes					13	19	3.0	4.0	30	38	35	45
Wanetta clay loam, 0 to 1 percent slopes	14	18	19	24	17	23	4.0	5.0	38	57	50	81
Wanetta clay loam, 1 to 4 percent slopes	13	16	18	22	16	21	4.0	5.0	36	54	47	76
Wanetta-Larim clay loams, 0 to 1 percent slopes	13	15	14	19	14	19	3.5	4.5	31	48	43	70
Wanetta-Larim clay loams, 1 to 4 percent slopes	12	14	13	18	12	17	3.0	4.0	30	45	40	62
Wanetta-Larim clay loams, 4 to 7 percent slopes							2.0	3.0	24	36	29	43
Yegen sandy loam, 0 to 1 percent slopes	17	20	22	27	19	28	4.5	6.0	44	60	58	95
Yegen sandy loam, 1 to 4 percent slopes	15	19	21	26	18	26	4.5	5.5	41	57	55	89
Yegen sandy loam, 4 to 10 percent slopes							3.0	4.0	38	52	45	70

For silage corn, average management consists of plowing in fall, irrigating at random times and sometimes too heavily, applying no fertilizer or manure, seeding less than 30,000 plants per acre, and harvesting at 90-day maturity. Improved management consists of plowing in fall, preparing the seedbed, applying 160 pounds of nitrogen and 100 pounds of phosphorus fertilizer per acre, applying manure, irrigating between the tasseling and silking stages of growth, spraying to kill weeds until the canopy develops, seeding about 30,000 plants per acre, and delaying harvest until 110- to 120-day maturity or the last killing frost.

For alfalfa hay, average management consists of applying 50 pounds of phosphorus fertilizer per acre, irrigating at random, and replanting after 4 to 6 years. Improved management consists of plowing under 120 pounds of phosphorus per acre, irrigating uniformly in border dikes, controlling alfalfa weevils, cutting no more than 3 times a year, and replanting after 4 years.

For winter wheat, average management consists of irrigating at random and applying no fertilizer. Improved management consists of applying 40 pounds of nitrogen and 15 pounds of phosphorus fertilizer per acre, controlling weeds, and irrigating uniformly by border dikes.

For barley, average management consists of irrigating at random and applying no fertilizer. Improved management consists of applying 50 pounds of nitrogen and 25 pounds of phosphorus fertilizer per acre, irrigating uniformly by border dikes, and timing the last irrigation to prevent lodging.

Predicted Yields of Dryfarmed Crops

In table 2 are listed the predicted yields per acre of dryfarmed winter wheat and barley. The yields are based on information provided mostly by farmers. The yields in columns A are for average management, and those in columns B are for improved management.

Average management of soils used for winter wheat consists of stubble mulch tillage, random fallow beginning late in May or early in June, seeding between August 30 and September 10, and spraying weeds in seeded crops. Improved management consists of stubble mulch tillage, fallow begun early enough (late in April or early in May) to control weeds, seeding after September 10, applying fertilizer where soil is moist to a depth of 36 inches or more, and spraying weeds in seeded crops and during fallow.

Average management of soils planted to barley consists of using a crop-fallow system and spraying weeds in the planted grain. Improved management consists of using a crop-fallow system, seeding early (by the middle of March, if possible), and spraying weeds in planted grain and during fallow.

The amount of water available in the soil during the growing season is the most important factor affecting dryfarmed crops. Rainfall from April to June is the most important for crop growth. Rain during the summer fallow period provides moisture for crops the next year. In fall, rain helps germinate new seedings and provide moisture for growth early in spring.

TABLE 2.—*Predicted average acre yields of dryfarmed winter wheat and barley under average and improved soil management*

[In columns A are yields under average management, and in columns B are yields that could be obtained under improved management. Absence of yield indicates soil is not suited to the crop. If a soil is not listed in this table, it is not suited to dryfarmed crops]

Soil	Winter wheat		Barley	
	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*
Absarokee clay loam, 1 to 4 percent slopes	26	30	37	44
Absarokee clay loam, 4 to 7 percent slopes	23	27	34	41
Amherst clay loam, 7 to 15 percent slopes	14	18	30	38
Amherst-Maginnis channery clay loams, 4 to 7 percent slopes	14	18	32	40
Apron fine sandy loam, 4 to 7 percent slopes	13	16	20	29
Bainville loam, 2 to 7 percent slopes	10	15	16	23
Bainville-Worland complex, 4 to 7 percent slopes	12	16	19	28
Bew silty clay loam, 0 to 1 percent slopes	17	24	24	30
Bew clay, 0 to 1 percent slopes	16	22	24	30
Bew clay, 1 to 4 percent slopes	16	22	24	30
Bew-Allentine clays, 0 to 1 percent slopes	14	18	23	29
Big Horn clay loam, 0 to 2 percent slopes	17	24	32	43
Cushman-Bainville loams, 1 to 4 percent slopes	14	18	30	38
Cushman-Bainville loams, 4 to 7 percent slopes	14	18	27	34
Danvers silty clay loam, 2 to 4 percent slopes	25	30	38	48
Danvers silty clay loam, 8 to 15 percent slopes	20	23	31	35
Danvers-Judith complex, 7 to 15 percent slopes	14	18	27	30
Danvers-Shaak clay loams, 7 to 15 percent slopes	20	24	31	37
Elso clay loam, 4 to 7 percent slopes	10	13	19	27
Farland-Lambert silt loams, 0 to 4 percent slopes	24	28	30	34
Fattig sandy clay loam, 4 to 7 percent slopes	14	18	20	30
Fort Collins-Arvada clay loams, 0 to 1 percent slopes	16	21	23	32
Fort Collins-Arvada clay loams, 1 to 4 percent slopes	16	20	23	31
Fort Collins and Thurlow clay loams, 0 to 1 percent slopes	18	24	26	35
Fort Collins and Thurlow clay loams, 1 to 4 percent slopes	17	24	26	35

TABLE 2.—*Predicted average acre yields of dryfarmed winter wheat and barley under average and improved soil management*—Continued

Soil	Winter wheat		Barley	
	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*
Gilt Edge-Allentine complex, 2 to 7 percent slopes	12	16	25	29
Glenberg fine sandy loam, 1 to 4 percent slopes	10	13	20	33
Glenberg loam, 0 to 1 percent slopes	14	20	21	28
Glenberg loam, gravelly substratum, 0 to 1 percent slopes	13	17	20	33
Grail clay loam, 2 to 4 percent slopes	22	28	24	36
Grail silty clay, 0 to 1 percent slopes	22	28	24	36
Grail soils, 2 to 15 percent slopes	22	28	32	39
Haverson loam, 0 to 1 percent slopes	17	21	24	34
Haverson loam, clay substratum, 0 to 1 percent slopes	18	23	26	35
Haverson clay loam, 0 to 1 percent slopes	18	24	27	36
Haverson silty clay loam, 0 to 1 percent slopes	18	23	26	35
Haverson silty clay loam, 1 to 3 percent slopes	18	22	26	32
Haverson-Hysham loams, 0 to 1 percent slopes	13	17	18	24
Heldt silty clay loam, 4 to 7 percent slopes	17	21	25	32
Hesper silty clay loam, 0 to 1 percent slopes	18	22	24	30
Hesper silty clay loam, 1 to 4 percent slopes	18	22	24	30
Hopley loam, 4 to 7 percent slopes	18	23	31	35
Hydro-Allentine complex, 2 to 7 percent slopes	12	16	20	27
Hydro-Arvada clay loams, 0 to 2 percent slopes	14	18	22	29
Keiser silty clay loam, 0 to 1 percent slopes	18	23	25	30
Keiser silty clay loam, 1 to 4 percent slopes	18	23	25	30
Keiser silty clay loam, 4 to 7 percent slopes	16	20	23	29
Kyle silty clay, 0 to 1 percent slopes	16	20	23	28
Kyle silty clay, 1 to 4 percent slopes	16	20	26	34
Kyle silty clay, 4 to 7 percent slopes	15	18	22	29
Lambert silt loam, 1 to 4 percent slopes	17	21	25	31
Lambert silt loam, 4 to 7 percent slopes	16	20	23	29
Lambert silt loam, 7 to 15 percent slopes	10	14	16	22
Larim loam, 0 to 4 percent slopes	8	12	14	17
Larim gravelly loam, 0 to 4 percent slopes	6	9	12	16
Larim gravelly loam, 4 to 7 percent slopes	6	9	11	16
Lavina loam, 2 to 4 percent slopes	10	13	15	21
Lohmiller silty clay loam, 3 to 7 percent slopes	17	21	24	30
Lohmiller silty clay, 0 to 1 percent slopes	18	22	26	34
Maginnis channery clay loam, 7 to 15 percent slopes	10	13	21	29
McRae loam, 0 to 1 percent slopes	18	23	26	35
McRae loam, 1 to 4 percent slopes	18	23	26	35
McRae loam, 4 to 7 percent slopes	16	22	25	34
McRae loam, 7 to 15 percent slopes	12	16	19	28
McRae-Hysham loams, 0 to 1 percent slopes	16	21	23	32
McRae-Hysham loams, 1 to 3 percent slopes	16	21	23	32
McRae-Hysham loams, 3 to 6 percent slopes	15	20	21	30
Midway-Razor clay loams, 4 to 7 percent slopes	14	18	20	29
Oburn-Shaak complex, 0 to 1 percent slopes	24	29	35	39
Oburn-Shaak complex, 1 to 4 percent slopes	22	27	31	35
Pierre clay, 4 to 7 percent slopes	10	13	19	23
Razor clay loam, 2 to 7 percent slope	18	22	26	30
Razor-Cushman complex, 2 to 4 percent slopes	18	22	26	30
Ryegate fine sandy loam, 2 to 4 percent slopes	15	20	22	31
Shaak silty clay loam, 0 to 1 percent slopes	28	33	43	52
Shaak silty clay loam, 1 to 4 percent slopes	26	31	40	48
Shonkin loam, 0 to 1 percent slopes	24	33	38	46
Shorey gravelly loam, 1 to 4 percent slopes	14	16	19	22
Shorey gravelly loam, 4 to 7 percent slopes	13	15	18	21
Thurlow clay loam, 0 to 1 percent slopes	20	24	30	35
Thurlow clay loam, 4 to 7 percent slopes	17	24	26	35
Toluca clay loam, 0 to 1 percent slopes	17	24	26	35
Toluca clay loam, 1 to 4 percent slopes	15	19	22	30
Toluca clay loam, 4 to 7 percent slopes	13	17	20	27
Treasure fine sandy loam, 1 to 4 percent slopes	15	20	23	29
Treasure fine sandy loam, 4 to 10 percent slopes	12	16	20	24
Wanetta loam, 0 to 1 percent slopes	16	20	29	37
Wanetta loam, 1 to 4 percent slopes	16	20	29	37
Wanetta gravelly loam, 0 to 2 percent slopes	14	18	25	35
Wanetta clay loam, 0 to 1 percent slopes	17	21	28	38
Wanetta clay loam, 1 to 4 percent slopes	16	20	27	36

TABLE 2.—*Predicted average acre yields of dryfarmed winter wheat and barley under average and improved soil management*—Continued

Soil	Winter wheat		Barley	
	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*
Wanetta-Larim clay loams, 0 to 1 percent slopes	14	17	22	29
Wanetta-Larim clay loams, 1 to 4 percent slopes	13	16	19	26
Wanetta-Larim clay loams, 4 to 7 percent slopes	13	15	19	24
Work clay loam, 1 to 4 percent slopes	26	30	29	39
Work clay loam, 4 to 7 percent slopes	19	25	28	38
Worland fine sandy loam, 2 to 7 percent slopes	13	16	20	30
Wormser clay loam, 1 to 4 percent slopes	20	26	29	38
Wormser clay loam, 4 to 7 percent slopes	19	25	31	42
Wormser-Lavina clay loams, 2 to 4 percent slopes	16	21	25	32
Wormser-Worland sandy loams, 4 to 7 percent slopes	18	24	27	35
Yegen sandy loam, 0 to 1 percent slopes	22	28	35	52
Yegen sandy loam, 1 to 4 percent slopes	21	27	32	49
Yegen sandy loam, 4 to 10 percent slopes	19	25	30	46

Use and Management of the Soils for Windbreaks

In this subsection the management of windbreaks is discussed, and the windbreak suitability groups in which the soils of the county have been placed are described.

Tree windbreaks

Tree windbreaks are planted on farms and rangeland to control snow drifting and soil blowing. They are most effective where trees are planted in rows at right angles to the direction of prevailing winds. In Yellowstone County windbreaks are generally required on dryland soils outside the river valleys. They are particularly effective in controlling soil blowing on cultivated sandy soils. In the irrigated valleys, they are planted mainly around feedlots and for home beautification.

Soil characteristics that affect windbreak suitability are the amount of and depth to lime, the depth to bedrock, the available water capacity, the texture, the amount of coarse fragments, the permeability, the degree of wetness, and the alkalinity and salinity of the soil. Trees and shrubs are selected that survive and grow rapidly on a given soil. Preparing the seedbed, conserving water, timely planting, controlling weeds, and preventing soil blowing in the seedbed are measures necessary to establish a windbreak.

Broad-leaved trees and shrubs planted for windbreaks in the county are American elm, green ash, Siberian elm, white willow, golden willow, cottonwood, Russian-olive, Siberian crabapple, Harbin pear, caragana, honeysuckle, lilac, chokecherry, American plum, skunkbush sumac, purple willow, buffaloberry, sandcherry, Nanking cherry, and dogwood.

Evergreen trees planted for windbreaks are ponderosa pine, Colorado blue spruce, Rocky Mountain juniper, Douglas-fir, and Scotch pine.

The hardiest species are caragana, Russian-olive, Siberian elm, green ash, ponderosa pine, and Rocky Mountain juniper. Willows and cottonwoods grow best on soils that are moist throughout the year.

Species that tolerate slight to moderate salinity or alkalinity in the soil are Russian-olive, buffaloberry, cottonwood, golden willow, white willow, Siberian elm, and Rocky Mountain juniper.

Windbreak suitability groups

The soils of Yellowstone County are placed in five groups according to their suitability for windbreak plantings. In the following paragraphs each windbreak suitability group is described, and the species of trees and shrubs most suitable to the group are listed. Windbreaks planted on any soil within a suitability group require similar management. Soils that are not in a windbreak suitability group are not suited to windbreak plantings. To identify the soils in a windbreak suitability group, refer to the "Guide to Mapping Units" at the back of this survey.

WINDBREAK SUITABILITY GROUP 1

This group consists of sandy loam, silt loam, and loamy soils more than 36 inches deep. These soils are mildly calcareous and have lime concentrated at a depth of less than 24 inches. Slopes are less than 8 percent.

These soils are well suited to windbreaks. Species suitable for planting on irrigated soils of this group are American elm, green ash, Siberian elm, Russian-olive, Siberian crabapple, Harbin pear, caragana, honeysuckle, lilac, chokeberry, American plum, skunkbush sumac, purple willow, sandcherry, Nanking cherry, and dogwood.

Species suitable for planting on dryland soils are green ash, Siberian elm, Russian-olive, Siberian crabapple Harbin pear, caragana, honeysuckle, lilac, chokeberry, American plum, skunkbush sumac, sandcherry, and Nanking cherry.

WINDBREAK SUITABILITY GROUP 2

This group consists of well-drained, clay loam, sandy loam, silty clay loam, and loam soils more than 20 inches deep. Slopes are 0 to 15 percent. Trees grow less well on these soils than on those in group 1 because the annual precipitation is less and the soils are shallower. The interval between rows is generally 20 feet.

Species well suited to irrigated soils are caragana, honeysuckle, lilac, chokecherry, American plum, skunkbush sumac, buffaloberry, sandcherry, Nanking cherry, Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Colorado blue spruce, Rocky Mountain juniper, Douglas-fir, Scotch pine, American elm, purple willow, white willow, golden willow, dogwood, and cottonwood.

Species well suited to dryland soils are caragana, honeysuckle, lilac, chokecherry, American plum, skunkbush sumac, buffaloberry, sandcherry, Nanking cherry, Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Colorado blue spruce, Rocky Mountain juniper, Douglas-fir, and Scotch pine.

WINDBREAK SUITABILITY GROUP 3

The soils in this group are deep clays and moderately deep loams and clays that are underlain by shale or gravel and sand, moderately deep sandy loams that are underlain by sandstone, and very gravelly soils that have a limy substratum. All these soils are well drained. Slopes are 0 to 15 percent, the available water capacity is low, and the permeability is slow. Only hardy species can be planted in nonirrigated soils. Tree rows should be planted 20 feet apart.

Species suited to irrigated soils are caragana, honeysuckle, lilac, chokecherry, skunkbush sumac, sandcherry, Nanking cherry, Russian olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Rocky Mountain juniper, Scotch pine, American plum, purple willow, buffaloberry, dogwood, American elm, white willow, golden willow, cottonwood, Colorado blue spruce, and Douglas-fir.

Species suited to dryland soils are caragana, honeysuckle, lilac, chokecherry, skunkbush sumac, sandcherry, Nanking cherry, Russian-olive, Siberian crabapple, green ash, Siberian elm, ponderosa pine, Rocky Mountain juniper, and Scotch pine.

WINDBREAK SUITABILITY GROUP 4

This group consists of shallow clay and sandy loam soils over loose gravel or bedrock. The soils contain more than 50 percent gravel or have an alkaline claypan at a depth of about 6 inches. Slopes are 0 to 15 percent. Only the hardiest trees and shrubs grow on these soils. Trees grow slowly and should be planted in rows 20 feet apart.

Species suited to irrigated soils are caragana, skunkbush sumac, sandcherry, Nanking cherry, Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, Rocky Mountain juniper, Scotch pine, honeysuckle, lilac, chokecherry, American plum, purple willow, buffaloberry, dogwood, green ash, Colorado blue spruce, and Douglas-fir.

Species suited to dryland soils are caragana, skunkbush sumac, sandcherry, Nanking cherry, Russian-olive, Siberian crabapple, Siberian elm, ponderosa pine, Rocky Mountain juniper, and Scotch pine.

WINDBREAK SUITABILITY GROUP 5

Lohmiller soils, seeped, 0 to 2 percent slopes, are the only soils in this group. These soils are moderately saline.

Species suited to irrigated soils are skunkbush sumac, purple willow, buffaloberry, Russian-olive, white willow, golden willow, cottonwood, Rocky Mountain juniper, honeysuckle, lilac, chokecherry, American plum, and Siberian crabapple.

Species suited to dryland soils are skunkbush sumac, purple willow, buffaloberry, Russian-olive, white willow, golden willow, cottonwood, and Rocky Mountain juniper.

Use and Management of the Soils for Range [3]

In this subsection the soils of the county are placed in range sites. These sites and their vegetation are described. Also, yields of forage are estimated for each site.

About 80 percent of Yellowstone County is rangeland. Most of this rangeland is rolling to steep and occurs on dissected uplands that border the major drainageways. Crops can be grown on about 10 to 15 percent of this land, but most areas formerly cultivated have been reseeded to range.

About 20 percent of the rangeland consists of loamy, silty, and clayey soils that are 20 to 36 inches deep over soft shale or loose gravel and have slopes of less than 20 percent. On these soils forage plants grow fairly well. About 14 percent of the rangeland consists of soils that are 36 inches deep over shale or gravelly sand and have slopes of less than 15 percent. On these soils forage plants grow very well. About 28 percent consists of steep soils less than 20 inches deep over shale, sandstone, or gravel. On these soils forage plants grow fairly well or poorly.

Sandy soils of varying depth over sandstone make up about 9 percent of the rangeland. These soils have slopes of less than 20 percent and are well suited to forage plants.

Clay soils make up about 14 percent of the rangeland. About 5 percent of the clay soils are more than 20 inches deep and have slopes of less than 20 percent. About 9 percent of the clay soils are steep and less than 20 inches deep over shale. Runoff is rapid, and forage plants grow poorly.

Gravelly, loamy soils that are 10 to 20 inches deep over loose, gravelly sand make up about 5 percent of the rangeland. On these soils forage plants grow poorly.

Barren shale, rockland, and riverwash make up about 5 percent of the rangeland. These are scattered areas of steep, eroded soils on which forage plants grow very poorly.

Saline and alkaline soils of all textures make up about 5 percent of the rangeland. These soils occur mainly in the stream valleys and have slopes of less than 8 percent. They are poorly suited to forage plants.

Range sites and condition classes

A range site is a kind of rangeland that differs from another kind in its ability to produce a significantly different kind or amount of native vegetation. Some permanent characteristic of the soil, such as depth, texture, salinity, or wetness, is given in the name of a range site to indicate its capacity for forage production. The precipitation zone in which the site is located also may be given. For example, "Sandy, 10- to 14-inch precipitation zone," is a range site designation.

Annual precipitation is about 11 to 14 inches in the northern half of the county and about 13 to 16 inches in

[3] Prepared by STERLE DALE, range conservationist, Soil Conservation Service.

the southern half and in the Bull Mountains. Because the amount of forage that grows normally depends on the amount of annual precipitation, range areas can be divided into three categories, according to the amount of water that is available for plants. The three categories are runoff areas, areas of normal precipitation, and run-in areas.

Runoff areas have soils that are too steep or too shallow to absorb or store most precipitation. The vegetation on these sites is sparse and consists of plants that provide small amounts of forage. Examples of runoff areas are Clayey and Shallow Limy range sites.

Areas of normal precipitation consist of deep soils on terraces, benchlands, or rolling hills that can absorb most of the annual precipitation and use it to produce vegetation. The soils differ mainly in texture of the surface layer. Designations of areas of normal precipitation are the Sandy, Silty, and Clayey range sites.

Run-in areas receive water in addition to the normal precipitation. Consequently, they produce more vegetation. The additional water may be obtained from surface runoff or underground seepage from other soils. Designations of run-in areas are the Wetland, Saline Subirrigated, and Overflow range sites.

As a soil forms, a combination of plants grows that is well suited to the soil and climate. This combination of plants is called native or climax vegetation. It provides a protective cover for the soil and is the most productive vegetation that a range site can permanently support without artificial treatment. Where climax vegetation is dominant, the range is in excellent condition.

Range vegetation consists of decreaser, increaser, and invader plants. Plants that are not able to survive close grazing are called decreasers. Decreasers normally produce the most forage and are taller and more conspicuous than associated plants. Decreasers generally are dominant in the climax vegetation, and where they are lost the amount of forage produced is substantially reduced.

The plants that replace the decreasers are called increasers. As decreasers are grazed out, increasers become more abundant. Increaser plants generally make up a smaller, undesirable part of the climax vegetation and have waxy leaves, thorns, or odors that make them unattractive to livestock. Because they are generally short and have small leaves, increasers are not so demanding of the soil, but they provide less forage and soil protection.

Invaders are plants that take over as grazing pressure continues and the decreasers and increasers are forced out. Invaders are unpalatable, weedy, or exotic plants that generally make up less than 3 percent of the original climax vegetation.

Range condition is determined by the extent to which current vegetation is equivalent to the climax vegetation for the site. The range condition is excellent if the plant cover is 76 to 100 percent climax vegetation, good if 51 to 75 percent, fair if 26 to 50 percent, and poor if less than 25 percent.

Range sites in Yellowstone County

In this subsection, the 19 range sites in Yellowstone County are discussed. By knowing his range site, the rancher can judge which plants are too plentiful and which are too few. He can decide when and how closely to graze different sites. He can plan stock-water ponds, salting places, fencings, herding, and trails for the purposes of insuring uniform, controlled grazing and conserving water and plants. To determine the soils in a range site, refer to the "Guide to Mapping Units" at the back of this soil survey.

WETLAND, 10- TO 14-INCH PRECIPITATION ZONE

Alluvial land, seeped, and Alluvial land, wet, are the only soils in this range site. These are nearly level, loam and silty clay loam soils that are underlain by gravelly sand below a depth of 36 inches. Seepage or ponding raises the water table to the surface during part of the growing season. The soils are too wet for cultivated crops and too dry for common reeds, cattails, or true aquatic plants.

The climax vegetation is 70 percent tall grass, 20 percent mid grass, 5 percent perennial forbs, and 5 percent woody plants. Decreaser plants are reed canarygrass, prairie cordgrass, Nebraska sedge, and bluejoint reedgrass. Increaser plants are sedges, willows, and shrubby cinquefoil.

Where this site is in poor condition, the dominant plants are needleleaf sedge, Rocky Mountain iris, blue-eyed grass, American sloughgrass, Kentucky bluegrass, and short-lived, broad-leaved perennial plants.

Wetland range sites provide green forage throughout the growing season. Adjacent range sites are less well watered, and their forage usually dries or cures in midsummer. The forage on wetland range sites is then very attractive, and it is difficult to keep livestock from trampling or overgrazing these sites. Wetland sites should be fenced to control grazing.

Seasonal variations in precipitation do not affect wetland range sites, and the yield of forage varies little from year to year. Where this range site is in excellent condition, the total annual air-dry yield is about 6,000 pounds of herbage per acre.

SALINE SUBIRRIGATED, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep, nearly level to gently sloping, loam and silty clay loam soils that contain salts. These soils occur along irrigation canals and natural drainageways that carry excess irrigation water during the growing season. A seasonal water table is at a depth of less than 60 inches. In some areas, salt has accumulated on the surface.

The climax vegetation is 90 percent salt-tolerant grasses and 10 percent salt-tolerant woody plants. The decreaser plants are alkali cordgrass, alkali sacaton, alkaligrass, and western wheatgrass. The increaser plants are greasewood and saltgrass.

Where this site is in poor condition, the dominant plants are foxtail barley, Russian-thistle, kochia, and seepweed.

Trampling and overgrazing are common because these sites are wetter and have greener forage than adjacent rangeland. It is advisable to fence sites that are large enough to justify the expense.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about

2,000 pounds of herbage per acre. In a dry year the yield is as low as 1,200 pounds per acre.

OVERFLOW, 10- TO 14-INCH PRECIPITATION ZONE

This site consists of deep, nearly level, clayey and loamy soils on uplands. These soils receive run-in water that collects in potholes and small lake basins. They are more than 60 inches deep. Permeability is slow to very slow.

The climax vegetation is 20 percent tall grass, 60 percent mid grass, 10 percent short grass, 5 percent perennial forbs, and 5 percent woody plants. The decreaser plants are slender wheatgrass and green needlegrass. The increaser plants are western wheatgrass, needle-and-thread, blue grama, and saltgrass.

Where this site is in poor condition, the dominant plants are foxtail barley, cheatgrass brome, and Japanese brome.

This Overflow range site provides green forage longer than do the adjacent rangelands that do not receive run-in water. To prevent trampling and overgrazing, it is advisable to fence areas that are large enough to justify the expense.

Where this site is in excellent condition, the total annual air-dry yield when moisture is average is about 1,800 pounds of herbage per acre. In a dry year the yield is as low as 1,500 pounds per acre.

OVERFLOW, 15- TO 19-INCH PRECIPITATION ZONE

Grail soils, 2 to 15 percent slopes, are the only soils in this range site. These soils have a silty clay and silty clay loam surface layer. They occur on gravel terraces. In some areas the soils are flooded mainly in spring.

The climax vegetation is 20 percent tall grass, 60 percent mid grass, 5 percent short grass, 5 percent perennial forbs, and 10 percent woody plants. The decreaser plants are western wheatgrass, green needlegrass, and bearded wheatgrass. The increaser plants are western wheatgrass, needle-and-thread, and forbs.

Where this site is in poor condition, the dominant plants are increaser and invader plants such as cheatgrass brome and Japanese brome.

This range site provides green forage well into the growing season. Because livestock prefer to graze on this site, fencing to prevent overgrazing is desirable.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 2,800 pounds of herbage per acre. In a dry year, the yield is as low as 2,400 pounds.

SANDS, 10- TO 14-INCH PRECIPITATION ZONE

Apron loamy fine sands are the only soils in this range site. These deep, sloping to moderately steep soils occur on uplands. They are underlain by soft sandstone.

The climax vegetation is 40 percent tall grass, 45 percent mid grass, 5 percent short grass, 5 percent perennial forbs, and 5 percent woody plants. The decreaser plants are prairie sandreed, sand bluestem, little bluestem, and Indian-ricegrass. The increaser plants are needle-and-thread, sand dropseed, and blue grama.

Where this range site is in poor condition, the dominant plants are cheatgrass brome, Japanese brome, annual eriogonum, and other short-lived perennials and annuals.

Soil blowing is the greatest hazard because close grazing and trampling deprive the soils of adequate cover vegetation. Deferred grazing is the only way to prevent range deterioration. Overgrazed areas recover rapidly because adequate water is available for plant growth.

Soils that have been cultivated for a number of years respond well to reseeding. However, preparing seedbeds on these sites may deprive the soil of cover sufficient to prevent soil blowing. If the condition of a site is not bad, natural plant succession is a more suitable method of restoring range condition than reseeding. Soils that have not been cultivated respond better to good grazing management than to reseeding.

Where this site is in excellent condition, the total annual air-dry yield when moisture is average is about 1,500 pounds of herbage per acre. In a dry year the yield is as low as 1,100 pounds per acre.

SANDY, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep and moderately deep, gently to strongly sloping, sandy loam, fine sandy loam, and sandy clay loam soils.

The climax vegetation is 20 percent tall grass, 65 percent mid grass, 10 percent short grass, and 5 percent perennial forbs. The decreaser plants are prairie sandreed, little bluestem, and Indian ricegrass. The increaser plants are western wheatgrass, needle-and-thread, sand dropseed, and blue grama.

Where this site is in poor condition, the dominant plants are short grass and invader plants such as cheatgrass brome, Japanese brome, wooly Indian-wheat, tumblegrass, and false buffalograss.

Proper range use is necessary to maintain range condition. Leaving the range ungrazed one season in three to five improves the forage. Well-placed fences and water sites insure good distribution of livestock over the range.

These soils can be reseeded if the seedbed is in excellent condition, if a suitable drill is used, and if native species are planted. The risk of soil blowing in seedbeds is high.

Where this site is in excellent condition, the total annual air-dry yield when moisture is average is about 1,200 pounds of herbage per acre. In a dry year the yield is as low as 900 pounds per acre.

SANDY, 15- TO 19-INCH PRECIPITATION ZONE

Yegen sandy loams are the only soils in this range site. These are deep, nearly level to strongly sloping soils that absorb water easily.

The climax vegetation is 15 percent tall grass, 65 percent mid grass, 5 percent short grass, 10 percent perennial forbs, and 5 percent woody plants. The decreaser plants are sand bluestem, little bluestem, and prairie sandreed. The increaser plants are Idaho fescue, needle-and-thread, and sand dropseed.

Where this site is in poor condition, the dominant plants are small, low-vigor increasers and invaders such as cheatgrass brome, Japanese brome, and various broadleaved annuals and biennials.

Soil blowing is the greatest hazard on these soils. Deferred grazing helps to maintain adequate cover vegetation. These soils can be reseeded.

Where this site is in excellent condition, the total annual air dry yield when moisture is average is about 2,200

pounds of herbage per acre. In a dry year the yield is as low as 1,800 pounds per acre.

SILTY, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of clay loam, silty clay loam, loam, and gravelly loam soils that are 20 to more than 60 inches deep. The surface soil and subsoil generally contain less than 35 percent clay. These soils are nearly level to steep and occur on terraces, foothills, alluvial fans, and flood plains.

The climax vegetation is 5 percent tall grass, 75 percent mid grass, 10 percent short grass, 5 percent perennial forbs, and 5 percent woody plants. The decreaser plants are western wheatgrass, bluebunch wheatgrass, and green needlegrass. The increaser plants are needle-and-thread, blue grama, Sandberg bluegrass, and threadleaf sedge.

Where this site is in poor condition, the dominant plants are short-lived perennials or annuals such as cheat grass brome, Japanese brome, wooly Indian-wheat, broom snakeweed, and rabbitbrush.

These soils can be reseeded. Eliminating brush improves range condition and increases the amount of forage produced.

Where this site is in excellent condition, the total annual air-dry yield when moisture is average is about 1,200 pounds of herbage per acre. In dry years the yield is as low as 800 pounds per acre.

SILTY, 15- TO 19-INCH PRECIPITATION ZONE

This range site consists of clay loam, silty clay loam, channery clay loam, and silty loam soils that are 20 to more than 60 inches deep. These soils are gently sloping to moderately steep and occur on terraces, foothills, alluvial fans, and flood plains.

The climax vegetation is 5 percent tall grass, 75 percent mid grass, 5 percent short grass, 10 percent perennial forbs, and 5 percent woody plants. The decreaser plants are Canby bluegrass, basin wildrye, bluebunch wheatgrass, and green needlegrass. The increaser plants are western wheatgrass, needle-and-thread, Idaho fescue, blue grama, Sandberg and Cussick bluegrasses, and western yarrow and lupine forbs.

Where this range is in poor condition, the dominant plants are Sandberg bluegrass and blue grama and invaders such as broom snakeweed, rabbitbrush, annuals, and weedy forbs. The soils on this site can be reseeded.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 2,200 pounds of herbage per acre. The yield in dry years is as low as 1,800 pounds per acre.

CLAYEY, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of nearly level to sloping, clay, clay loam, silty clay loam, and silty clay soils that are 20 to 60 inches deep.

The climax vegetation is 75 percent mid grass, 10 percent short grass, 10 percent perennial forbs, and 5 percent woody plants. The decreaser plants are green needlegrass and western, Montana, and bluebunch wheatgrasses. The increaser plants are plains reedgrass, blue grama, big sagebrush, Sandberg bluegrass, and greasewood.

Where this site is in poor condition, the dominant plants are annual bromes, fescues, broad-leaved plants, and perennial half shrubs.

The soils of this range site can be reseeded. Sites in poor condition that have a large number of big sagebrush plants can be restored by using chemicals to eradicate the sagebrush and by leaving the range ungrazed for 2 years.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 1,200 pounds of herbage per acre. In dry years the yield is as low as 800 pounds per acre.

CLAYEY, 15- TO 19-INCH PRECIPITATION ZONE

Grail silty clay and clay loam are the only soils in this range site. These nearly level to moderately steep soils occur on stream terraces and fans.

The climax vegetation is 5 percent tall grass, 75 percent mid grass, 5 percent short grass, 5 percent perennial forbs, and 10 percent woody plants. The decreaser plants are green needlegrass and bluebunch wheatgrass. The increaser plants are blue grama, plains reedgrass, Sandberg bluegrass, big sagebrush, greasewood, and fringed sagewort.

Where this site is in poor condition, the dominant plants are annual grasses and forbs, cheatgrass brome, Japanese brome, wooly Indian-wheat, biennial curlycup gumweed, perennial Kentucky and Canadian bluegrasses, and broom snakeweed. These soils can be reseeded.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 2,200 pounds of herbage per acre. In dry years the yield is as low as 1,800 pounds per acre.

THIN SILTY, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of shallow, silty and loamy soils underlain by soft shale that can be penetrated easily by plant roots. These soils occur on hilly uplands and are strongly sloping to very steep.

The climax vegetation is 70 percent mid grass, 15 percent short grass, 10 percent perennial forbs, and 5 percent woody plants. The decreaser plants are western wheatgrass, green needlegrass, and little bluestem. The increaser plants are needle-and-thread, prairie junegrass, plains muhly, and blue grama.

Where this site is in poor condition, the dominant plants are annual bromes and fescues, short-lived perennial shrubs, and broad-leaved forbs. Soils on slopes of less than 25 percent can be reseeded, but deferred grazing and proper use are better in maintaining range condition.

When this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 900 pounds of herbage per acre. The yield in dry years is as low as 600 pounds per acre.

THIN SILTY, 15- TO 19-INCH PRECIPITATION ZONE

Clapper clay loam, 15 to 35 percent slopes, is the only soil in this range site. It occurs on high terraces and fans and is over soft shale that can be penetrated easily by plant roots. Gravel and larger fragments are on the surface and in the soil layers.

The climax vegetation is 70 percent mid grass, 10 percent short grass, 10 percent perennial forbs, and 10

percent woody plants. The decreaser plants are green needlegrass and bluebunch, bearded, and slender wheatgrasses. The increaser plants are western wheatgrass, Idaho fescue, needle-and-thread, and blue grama.

Where this site is in poor condition, the dominant plants are increasers that have little vigor, including annual bromes and fescues and biennial broad-leaved forbs.

The soil responds to good grazing management, brush control, and reseeding. Because it is steep, proper use and deferred grazing are good ways to maintain range condition.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 1,500 pounds of herbage per acre. In dry years the yield is as low as 1,200 pounds per acre.

THIN CLAYEY, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of clay loam soils underlain by soft shale. Plant roots penetrate the soft shale easily. The soils are on hilly uplands and have slopes of 15 to 35 percent.

The climax vegetation is 70 percent mid grass, 20 percent short grass, and 10 percent perennial forbs. The decreaser plants are green needlegrass, western wheatgrass, and bluebunch wheatgrass. The increaser plants are prairie junegrass, plains reedgrass, plains muhly, and big sagebrush.

Where this site is in poor condition, the dominant plants are cheatgrass brome, Japanese brome, and annual forbs. The increaser plants have little vigor. Reseeding and brush control are feasible in less steep areas.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 900 pounds of herbage per acre. In dry years the yield is as low as 600 pounds per acre.

SHALLOW TO GRAVEL, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of gravelly loam and clay loam soils 10 to 20 inches thick. These soils are droughty and rapidly permeable. They occur on low river terraces, on gravel-capped uplands, and along steep terrace edges. Most of the soils are nearly level to sloping, but some have slopes of 15 to 35 percent.

The climax vegetation is 5 percent tall grass, 50 percent mid grass, 40 percent short grass, and 5 percent perennial forbs. The decreaser plants are bluebunch wheatgrass, western wheatgrass, and needle-and-thread. The principal increaser plant is blue grama.

Where this range is in poor condition, the dominant plants are annual bromes and fescues, biennial forbs, and short-lived increasers. These soils can be reseeded.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 800 pounds of herbage per acre. The yield in dry years is as low as 500 pounds per acre.

SHALLOW LIMY, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of loamy and fine sandy loam soils that are 10 to 20 inches deep over hard sandstone and sandy shale. These soils are gently sloping to strongly sloping.

The climax vegetation is 65 percent mid grass, 20 percent short grass, 10 percent perennial forbs, and 5 percent woody plants. The decreaser plants are western wheatgrass, bluebunch wheatgrass, needle-and-thread, and little bluestem. The increaser plants are sand dropseed, plains muhly, blue grama, and threadleaf sedge.

Where this site is in poor condition, the dominant plants are the increasers annual cheatgrass brome, Japanese brome, and forbs. These plants have little vigor.

Because the available water capacity of the soils in this range site is low, vegetation is sparse and easily overgrazed. Deferred grazing, proper use, and reseeding are ways to maintain range condition.

Where this range site is in excellent condition, the total annual air dry yield when moisture is average is about 800 pounds of herbage per acre. In dry years the yield is as low as 500 pounds per acre.

SHALLOW NONLIMY, 15- TO 19-INCH PRECIPITATION ZONE

Maginnis channery clay loams are the only soils in this range site. These strongly sloping to steep soils are 10 to 20 inches deep over shale. Rocks crop out on the steepest slopes.

The climax vegetation is 70 percent mid grass, 10 percent short grass, 10 percent perennial forbs, and 10 percent woody plants. The decreaser plants are bluebunch wheatgrass, bearded wheatgrass, mountain brome, and Canby bluegrass. The increaser plants are Idaho fescue, western wheatgrass, needle-and-thread, and prairie junegrass.

Where this range site is in poor condition, the dominant plants are increasers and invader plants that have little vigor. Among these plants are cheatgrass brome, Japanese brome, and broad-leaved annuals. Reseeding is not practical in most areas, because the soils are shallow, stony, and steep.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 800 pounds of herbage per acre. In dry years the yield is as low as 500 pounds per acre.

SALINE UPLAND, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of deep, nearly level to sloping, silty clay, silty clay loam, and clay soils that are strongly saline.

The climax vegetation is 45 percent mid grass, 50 percent short grass, and 5 percent woody plants. The decreaser plants are western wheatgrass and alkali sacaton. The increaser plants are greasewood, saltgrass, and bottlebrush squirreltail.

Where this site is in poor condition, the dominant plants are annual saltbushes, Russian-thistle, and foxtail barley.

Proper use and deferred grazing are necessary to maintain range condition. The soils can be reseeded with salt-tolerant plants.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 300 pounds of herbage per acre. In very dry years the yield is practically none.

SHALE, 10- TO 14-INCH PRECIPITATION ZONE

This range site consists of shallow, strongly sloping to very steep clay soils and barren shale outcrops. Runoff is rapid, and the hazard of erosion is high.

The climax vegetation is 65 percent mid grass, 20 percent short grass, 10 percent perennial forbs, and 5 percent woody plants. The decreaser plants are western wheatgrass, green needlegrass, alkali sacaton, plains reedgrass, and plains muhly. The increaser plants are Sandberg bluegrass, bottlebrush squirreltail, greasewood, and perennial forbs.

Where this range site is in poor condition, the dominant plants are annual bromegrass, forbs, and other increasers that have little vigor. Forage yields are so small that reseeding is not worthwhile.

Where this range site is in excellent condition, the total annual air-dry yield when moisture is average is about 200 pounds of herbage per acre. In very dry years the yield is practically none.

Engineering Uses of the Soils [4]

This subsection (1) lists engineering uses that can be made of the information in this soil survey; (2) briefly explains the two systems of classification generally used by engineers; (3) lists test data obtained when selected soils were tested to determine their engineering properties; (4) lists properties of each soil that are important in engineering; and (5) interprets those properties.

The engineer is primarily interested in how the soil functions as construction material. He is, therefore, concerned with those properties of the soil that determine its suitability as building material and that limit its use in construction. The physical properties of soil material that is used for structural purposes are determined by well-established laboratory and field methods.

Many soil properties affect the construction, operation, and maintenance, of roads, airports, pipelines, and building foundations; of facilities for water storage and erosion control; and of systems for irrigation, drainage, or sewage disposal. Among the properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell potential, grain-size distribution, plasticity, depth, and reaction. Also important are depth to the water table and to bedrock, available water capacity, and topography.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where excavations are deeper than the depth of the layers here reported. But even in those situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected. The information in this survey can be used to—

1. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
2. Make preliminary evaluations of soil conditions that will aid in selecting the location of highways, airports, pipelines, and cables and in planning detailed investigations at the selected locations.
3. Locate probable sources of sand, gravel, and rock that may be used in construction.
4. Aid in selecting and planning industrial, business, residential, and recreational sites.
5. Correlate performance of engineering structures with soil mapping units to develop information for planning that will be useful in designing and maintaining structures.
6. Determine the suitability of soil mapping units to withstand cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published reports and aerial photographs to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction pertinent to a particular area.

Most of the information in this subsection is in tables 3, 4, and 5, but additional information useful to the engineer can be found in other parts of the report, particularly in the sections "Descriptions of the Soils" and "Formation and Classification of the Soils."

Engineering classification systems

Two systems are commonly used by engineers for classifying soils according to their relative suitability for use in road construction. One of these systems was developed by the American Association of State Highway Officials and is commonly called the AASHO system (*1*). The other was adopted by the Corps of Engineers, United States Army, and is known as the Unified System (*10*).

The AASHO system classifies soils on the basis of their field performance in road construction. In this system all soils are grouped into seven major groups on the basis of their bearing strength and capacity. The groups range from A–1, the best, which consists of gravelly soils having high bearing capacity, to A–7, the poorest, which consists of clayey soils having low bearing strength when wet. Some of the groups are divided into subgroups. In each group or subgroup, the relative engineering value of the soil material is indicated by a group index. Group indexes range from 0 for the best materials to 20 for the poorest. In table 3 the group index is shown in parentheses following the symbol of the soil group.

The Unified system is based on the identification of soils according to their texture, plasticity, and liquid limit. The soils are placed in groups according to their performance as engineering construction material. Three important properties form the basis of the soil identification: (1) percentages of the gravel, sand, and the fine fraction that pass a No. 200 sieve; (2) shape of the grain-size distribution curve; and (3) plasticity and compressibility characteristics. The four fractions recognized are cobblestones, gravel, sand, and fines (silt or clay). In the Unified system the soils are divided into three main divisions: (1) coarse-grained soils, (2) fine-grained soils, and

[4] By R. H. GAGLE, Montana State Highway Department, and F. WODNIK, Soil Conservation Service.

TABLE 3.—*Engineering*

[Tests performed by the Montana State Highway Commission in cooperation with U.S. Department of Transportation, Federal

Soil type and location	Parent material	Montana report No.	Depth	Moisture-density[1] Maximum dry density	Moisture-density[1] Optimum moisture content
			Inches	*Lb. per cu. ft.*	*Percent*
Cushman loam: 50 feet north and 700 feet west of N¼, sec. 16, T. 4 N., R. 25 E.	Shale interbedded with sandstone.	216693	0–6	107	17
		213527	6–10	104	20
		213528	13–23	110	16
Lohmiller silty clay: ¼ mile south and 165 feet east of center of sec. 2, T. 1 S., R. 25 E. (Without salinity or alkalinity).	Alluvium (terrace).	216691	0–6	104	20
		213521	6–13½	104	19
		213522	21–72	108	19
McRae loam: 1,350 feet south and 330 feet east of W¼ corner, sec. 19, T. 4 N., R. 33 E.	Local alluvium.	216696	0–5	106	16
		213534	9–34	110	15
		213535	34–76	113	14
Pierre clay: 1,500 feet east of NW. corner, sec. 9, T. 2 N., R. 25 E.	Fissile clay shale.	216690	0–2	97	23
		213517	4–10	97	24
		213518	19–24	104	22
Worland fine sandy loam: 115 feet north and 180 feet east of SW. corner, sec. 36, T. 2 N., R. 26 E.	Calcareous sandstone.	216694	4–9	107	16
		213530	9–30	106	16
		213531	30–44	103	18

[1] Based on AASHO Designation: T 99–57, Methods A and C (*1*).

[2] Mechanical analyses according to the AASHO Designation: T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for naming textural classes for soils.

TABLE 4.—*Estimated engineering*

Soil series and map symbol	Depth to hard bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO
	Inches	*Inches*			
Absarokee: Aa, Ab	20–40	0–14	Clay loam, clay	CL	A–6
		14–33	Very channery clay loam	GC	A–2
		33	Sandstone or shale.		
Allentine (Mapped only with Bew, Gilt Edge, and Hydro soils in complexes.)	20–40 on uplands	0–55	Clay	CH	A–7
	>60 on terraces	55–60	Very gravelly sandy loam	GP–GM	A–2
Amherst: Ao, Ap (For properties of the Maginnis soil in Ap, refer to the Maginnis series.)	10–20	0–16	Channery loam, clay	GC or SC	A–2
		16	Sandstone or shale.		
Apron: Ar, As, At (For properties of the Travessilla soil in At, refer to the Travessilla series.)	>60	0–60	Fine sandy loam overlying loamy very fine sand.	SM	A–4
Arvada: Au, Av, Aw, Ax, Ay (For properties of the Bone soil in Ax and Ay, refer to the Bone series.)	>60	0–28	Clay	CH	A–7
		28–60	Stratified clay loam, loam, and fine sandy loam.	ML or CL	A–4 or A–6

test data

Highway Administration, in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve				Percentage smaller than—							
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO [3]	Unified [4]
---	100	99	69	61	46	22	10	28	8	A-4(7)	CL
---	---	100	79	70	52	25	13	34	15	A-6(10)	CL
---	100	98	74	63	46	30	17	29	12	A-6(9)	CL
---	---	100	81	78	63	44	27	34	13	A-6(9)	CL
---	---	100	82	72	57	42	29	32	13	A-6(9)	CL
---	100	98	80	73	60	45	35	35	17	A-6(11)	CL
---	100	98	72	50	34	13	8	24	3	A-4(7)	ML
---	---	100	71	56	28	16	11	21	0	A-4(7)	ML
---	---	100	77	64	39	21	11	23	4	A-4(8)	ML-CL
---	100	98	89	87	70	46	25	42	17	A-7-6(11)	ML-CL
---	100	98	92	86	76	60	40	49	23	A-7-6(15)	ML-CL
[5] 87	62	42	34	32	27	20	15	44	20	A-2-7(2)	SC
---	100	99	35	30	21	10	8	25	0	A-2-4(0)	SM
100	95	93	29	29	20	10	5	24	0	A-2-4(0)	SM
[5] 90	85	84	26	22	14	9	4	[6] NP	[6] NP	A-2-4(0)	SM

[3] Based on AASHO Designation: M 145-49 (*1*).
[4] Based on the Unified Soil Classification System, MIL-STD-619B, 1968 (*10*). Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points from A-line are to be given a borderline classification.
[5] 100 percent passed the ¾-inch sieve.
[6] NP=Nonplastic.

properties of soils

Percentage passing sieve—			Permeability in place	Available water capacity	Reaction	Salinity	Corrosivity of untreated steel pipe	Shrink-swell potential	Frost-action potential
No. 4	No. 10	No. 200							
			Inches per hour	*Inches per inch of soil*	*pH*				
90–100	80–100	80–90	0.2–0.63	0.18–0.20	7.4–7.8	None	Moderate	Moderate	Moderate.
40–50	35–45	25–35	0.2–0.63	0.08–0.10	7.4–7.8	None	Low	Low	Low.
---	100	80–90	0.06–0.20	0.14–0.16	7.9–8.4	Moderate to high.	High	High	Moderate.
45–55	35–50	10–20	6.3–20.0	0.04–0.06	7.9–9.0	Moderate to high.	High	Low	Low.
60–90	50–70	25–35	0.63–2.0	0.08–0.10	7.4–7.8	None	Moderate	Low to moderate.	Low.
100	90–100	40–50	6.3–20.0	0.11–0.13	6.6–8.5	None	Low	Low	High.
---	100	80–90	<0.06	0.12–0.14	7.9–9.2	Moderate to very high.	High	High	Moderate.
---	100	50–70	0.60–0.20	0.12–0.14	7.9–9.2	High	High	Low to moderate.	Moderate to high.

TABLE 4.—*Estimated engineering*

Soil series and map symbol	Depth to hard bedrock	Depth from surface	Classification		
			Dominant USDA texture	Unified	AASHO
	Inches	*Inches*			
Bainville:					
Bb, Bc, Be, Bf, Bg, Bl (For properties of Elso soil in Bc and Bf and Worland soil in Bl, refer to their respective series).	20–40	0–30	Silt loam	ML or ML-CL.	A–4
			Silty shale.		
Bew:					
Bm, Bn, Bo, Br (For properties of Allentine soil in Br, refer to the Allentine series.)	>60	0–46	Clay	CH	A–7
		46–60	Heavy clay loam	CL	A–6
Big Horn:					
Bs	48–60	0–9	Clay loam	CL	A–6
		9–48	Clay	CH	A–7
		48–55	Heavy sandy clay loam	CL	A–6
		55	Shale or sandstone.		
Bone:					
Bt, Bu, Bv	>60	0–52	Clay or silty clay	CH	A–7
		52–62	Stratified fine sandy loam, clay loam, and loam.	ML or CL	A–4 or A–6
Clapper:					
Ca, Cg	>60	0–13	Gravelly loam or clay loam	GM or CL	A–4 or A–6
		13–60	Very gravelly loam	GM	A–2
Cushman:					
Cn, Cm (For properties of Bainville soil in these units, refer to the Bainville series.)	20–40	0–13	Light clay loam	ML or CL	A–6
		13–28	Loam and sandy loam	ML	A–4
		28	Sandstone or shale.		
Danvers:					
Da, Dn, Dr, Ds (For properties of the Judith soil in Dr and of the Shaak soil in Ds, refer to their respective series.)	>60	0–19	Silty clay	CL or CH	A–6 or A–7
		19–60	Clay loam	CL	A–6
Elso:					
Ec, El, Eo, Es (For properties of the Lohmiller soil in Es, refer to the Lohmiller series.)	10–20	0–12	Clay loam or silty clay loam	CL	A–6
		12	Shale.		
Farland:					
Fa (For properties of the Lambert soil in this unit, refer to the Lambert series.)	>60	0–60	Silt loam	ML or CL	A–4 or A–6
Fattig:					
Fg	20–40	0–33	Sandy clay loam	SC	A–4
		33	Sandstone or shale.		
Fort Collins:					
Fl, Fo, Fr, Ft (For properties of the Arvada soil in Fl and Fo and of the Thurlow soil in Fr and Ft, refer to their respective series.	>60	0–60	Clay loam or loam	CL	A–4 or A–6
Gilt Edge:					
Ga (For properties of the Allentine soil in this unit, refer to the Allentine series.)	20–40	0–6	Loam	ML	A–4
		6–37	Clay	CH	A–7
		37	Sandstone and shale.		
Glenberg:					
Gh, Gl, Go	>60	0–40	Fine sandy loam, loam, or loamy fine sand.	SM	A–4
		40–60	Very gravelly loamy sand	GW or SW	A–1
Grail:					
Gr, Gt	>60	0–25	Heavy clay loam	CL	A–6 or A–7
		25–60	Gravelly clay loam	GC	A–2
Gs	>60	0–60	Silty clay or heavy silty clay loam.	CL or CH	A–7

properties of soils—Continued

Percentage passing sieve— No. 4	No. 10	No. 200	Permeability in place	Available water capacity	Reaction	Salinity	Corrosivity of untreated steel pipe	Shrink-swell potential	Frost action potential
			Inches per hour	*Inches per inch of soil*	*pH*				
--------	100	90–100	0. 63–2. 0	0. 18–0. 20	7. 9–9. 0	Low to moderate.	Moderate to high.	Low	High.
--------	100	85–95	0. 06–0. 20	0. 14–0. 16	6. 5–8. 4	Low	High	High	Moderate.
--------	100	80–90	0. 2–0. 63	0. 17–0. 19	7. 9–8. 4	Low	Moderate	High	Moderate.
100	95–100	75–90	0. 63–2. 0	0. 18–0. 20	6. 6–7. 3	None	Moderate	Moderate	Moderate.
100	90–95	70–85	0. 2–0. 63	0. 14–0. 16	7. 4–8. 4	Low	High	High	Moderate.
100	70–85	50–60	0. 2–0. 63	0. 14–0. 16	7. 9–8. 4	Low	Moderate	Moderate	Moderate.
--------	100	90–95	<0. 06	0. 12–0. 14	8. 5–9. 6	High to very high.	High	High	Moderate.
--------	100	70–85	0. 2–0. 63	0. 12–0. 14	8. 5–9. 0	Very high.	High	Low to moderate.	Moderate to high.
70–95	60–90	35–80	0. 63–2. 0	0. 10–0. 11	7. 9–8. 4	Low	Low to moderate.	Low to moderate.	Low to moderate.
30–40	20–35	10–25	0. 63–2. 0	0. 05–0. 07	7. 9–8. 4	Low	Low to moderate.	Low	Low.
--------	100	70–80	0. 2–0. 63	0. 18–0. 20	6. 6–7. 3	None	Moderate	Moderate	Moderate.
90–100	80–100	60–70	0. 2–0. 63	0. 14–0. 16	7. 9–8. 4	Low	Moderate	Low	Moderate to high.
90–100	85–95	70–80	0. 2–0. 63	0. 14–0. 16	6. 6–7. 8	None	High	High	Moderate.
90–100	80–90	70–80	0. 2–0. 63	9. 16–0. 18	7. 9–8. 4	None	Moderate	Moderate	Moderate.
90–100	85–95	70–80	0. 63–2. 0	0. 18–0. 20	7. 9–8. 4	None to low	Moderate	Moderate	Moderate to high.
--------	99–100	80–90	0. 63–2. 0	0. 18–0. 20	6. 6–8. 4	None	Low	Low	High.
90–100	85–95	35–50	0. 2–0. 63	0. 14–0. 16	7. 4–8. 4	None to low	Moderate	Moderate	Moderate.
--------	100	70–80	0. 2–9. 63	0. 17–0. 19	6. 6–8. 4	None to low	Moderate	Moderate	Moderate to high.
--------	100	70–85	0. 63–2. 0	0. 16–0. 18	6. 6–7. 3	None	Low	Low	Moderate to high.
--------	100	85–95	0. 06–0. 20	0. 14–0. 16	7. 9–9. 0	Moderate	High	High	Moderate.
--------	100	35–50	2. 0–6. 3	0. 13–0. 15	7. 4–8. 4	None to low	Low to moderate.	Low	Moderate to high.
25–70	20–50	0–10	>20	0. 05–0. 07	7. 9–8. 4	None to low	Low to moderate.	Low	Low.
--------	100	85–95	0. 06–0. 2	0–17–0. 19	7. 4–8. 4	None to low	Moderate	High	Moderate.
50–65	45–60	20–35	0. 2–0. 63	0. 07–0. 09	7. 9–8. 4	None to low	Moderate	Low to moderate.	Low to moderate.
--------	100	85–95	0. 06–0. 2	0. 16–0. 18	7. 4–8. 4	None	High	High	Moderate.

TABLE 4.—*Estimated engineering*

Soil series and map symbol	Depth to hard bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO
	Inches	*Inches*			
Haverson:					
Ha, Hc, Hd, He, Hh, Hl, Hm (For properties of the Hysham soil in Hh and of the Lohmiller soil in Hl and Hm, refer to their respective series.)	>60	0–58	Loam	ML or CL	A–4
		58–68	Very gravelly sand	GW	A–1
Hb	>60	0–36	Loam	ML	A–4
		36–60	Silty clay	CH	A–7
Hn	>60	0–30	Loam	ML	A–4
		30–60	Very gravelly sand	GW	A–1
Heldt:					
Ho	>60	0–63	Heavy silty clay loam or silty clay.	CL or CH	A–6 or A–7
Hesper:					
Hp, Hr	>60	0–44	Clay loam or silty clay loam	CL	A–6
		44–60	Loam or very fine sandy loam	ML	A–4
Hilly gravelly land:					
Hs	>60	0–15	Very gravelly loam	GM	A–2
		15–60	Very gravelly sand	GW	A–1
Hopley:					
Ht	>60	0–47	Loam	ML	A–4
		47	Weathering sandstone or shale.		
Hovert:					
Hu	>60	0–60	Clay	CH	A–7
Hydro:					
Hv, Hw (For properties of the Allentine soil in Hv and the Arvada soil in Hw, refer to their respective series.)	>60	0–41	Clay	CH	A–7
		41–60	Clay loam	CL	A–6
Hysham:					
Hx, Hy, Hz (For properties of the Laurel soil in Hx and Hy and the Haverson soil in Hz, refer to their respective series.)	>60	0–55	Loam or silt loam	ML	A–4
		55–57	Sand and gravel	GW	A–1
Judith (Mapped only with Danvers soil in a complex.)	>60	0–17	Clay loam and some gravel	CL	A–6
		17–50	Very gravelly clay loam	GC or SC	A–2
Keiser:					
Kc, Ke, Kg, Kh (For properties of the Hesper soil in Kh, refer to the Hesper series.)	>60	0–23	Silty clay loam	CL	A–6
		23–60	Silt loam	ML or CL	A–4
Kyle:					
Kl, Km, Kn	40–60	0–60	Clay	CH	A–7
Lambert:					
La, Lb, Lc, Ld	>60	0–60	Silt loam	ML or CL	A–4 or A–6
Larim:					
Le, Lg, Lh, Ll	>60	0–16	Gravelly clay loam	GC	A–4
		16–60	Very gravelly sand	GW	A–1
Laurel (Mapped only with Hysham soils in complexes.)	>60	0–52	Stratified loam, clay loam, and silty clay.	CL or CH	A–6 or A–7
		52–60	Sandy loam	SM	A–4

properties of soils—Continued

Percentage passing sieve—			Permeability in place	Available water capacity	Reaction	Salinity	Corrosivity of untreated steel pipe	Shrink-swell potential	Frost-action potential
No. 4	No. 10	No. 200							
			Inches per hour	*Inches per inch of soil*	*pH*				
--------	100	60–80	0.63–2.0	0.15–0.17	7.9–8.4	Low to moderate.	Moderate to high.	Low to moderate.	High.
20–30	15–25	0–10	>20	0.04–0.06	7.9–8.4	Low to moderate.	Moderate to high.	Low	Low.
--------	100	60–80	0.63–2.0	0.15–0.17	7.9–8.4	Low to moderate.	Moderate to high	Low to moderate.	High.
--------	100	80–95	0.06–0.20	0.14–0.16	8.5–9.0	Low to moderate.	Moderate to high.	High	Moderate.
--------	100	60–80	0.63–2.0	0.15–0.17	7.9–8.4	None to low	Low to moderate.	Low to moderate.	High.
20–30	15–25	0–10	>20	0.04–0.06	7.9–8.4	None to low	Low to moderate.	Low	Low.
--------	100	80–95	0.06–0.20	0.15–0.17	7.9–8.4	Low to moderate.	High	High	Moderate.
90–100	90–100	80–90	0.2–0.63	0.18–0.20	6.6–8.4	None to low	Moderate	Moderate	Moderate to high.
90–100	90–100	55–65	0.63–2.0	0.15–0.17	7.9–9.0	None to low	Low to moderate.	Low	High.
35–55	30–50	15–30	2.0–6.3	0.07–0.09	6.6–7.3	None	Low	Low	Low.
30–45	15–35	0–10	>20	0.04–0.06	7.9–8.4	None to low	Low to moderate.	Low	Low.
--------	100	55–70	0.63–2.0	0.14–0.16	6.6–8.4	None	Low	Low	High.
--------	100	85–95	0.06–0.20	0.14–0.16	6.6–8.4	None to low	High	High	Moderate.
--------	100	80–90	0.06–0.20	0.14–0.16	7.4–8.4	None to low	High	High	Moderate.
--------	100	70–80	0.20–0.63	0.18–0.20	8.5–9.0	None	Moderate	Moderate	Moderate.
--------	100	50–80	0.06–0.20	0.14–0.16	8.5–9.5	Low to very high.	High	Low	High.
20–40	15–35	0–10	>20	0.04–0.06	8.5–9.5	Low to very high.	High	Low	Low.
80–95	75–90	50–70	0.20–0.63	0.14–0.16	7.9–8.4	None	Moderate	Moderate	Moderate.
50–70	45–65	25–35	0.20–0.63	0.08–0.10	8.4–9.0	None	Low	Low	Low.
--------	100	80–90	0.20–0.63	0.18–0.20	6.6–8.4	None	Moderate	Moderate	High.
--------	100	80–90	0.20–0.63	0.18–0.20	7.9–9.0	Low to moderate.	Moderate to high.	Low	High.
--------	100	90–100	0.06–0.20	0.14–0.16	7.4–9.0	Low to moderate.	High	High	Moderate.
--------	100	80–100	0.2–0.63	0.18–0.20	7.9–8.4	None	Low	Low	High.
75–85	60–80	35–50	0.63–2.0	0.12–0.14	6.6–7.3	None	Low to moderate.	Low	Low.
30–50	20–40	0–5	>20	0.03–0.05	7.9–8.4	None	Low	Low	Low.
--------	100	75–95	0.2–8.0	0.16–0.18	8.5–9.0	Very high	High	Moderate	Moderate.
--------	100	35–50	2.0–6.3	0.11–0.13	9.0–9.6	Very high	High	Low	Moderate.

TABLE 4.—*Estimated engineering*

Soil series and map symbol	Depth to hard bedrock	Depth from surface	Classification		
			Dominant USDA texture	Unified	AASHO
	Inches	*Inches*			
Lavina:					
Lm	8–20	0–19 19	Clay loam Sandstone.	ML or CL	A-4 or A-6
Lismas:					
Ln	10–20	0–10 10	Clay Shale.	CH	A–7
Lohmiller:					
Lo, Lr, Ls, Lt, Lu (For properties of the Elso soil in Lt and the Hysham soil in Lu, refer to their respective series.)	>60	0–42 42–60	Silty clay or clay Fine sandy loam	CL CL	A–6 or A–7 A–6 or A–7
Lv	>60	0–30 30–60	Silty clay Very gravelly sand	CL GW	A–6 A–1
Maginnis:					
Ma, Mc, Mg (Rock outcrop in Mg not rated.)	>4–15	0–10 10	Very channery heavy clay loam. Shale.	GC	A–2
McKenzie:					
Mk	>60	0–65	Clay	CH	A–7
McRae:					
Mm, Mn, Mo, Mr, Ms, Mt, Mu, Mv (For properties of the Bainville soil in Ms and the Hysham soil in Mt, Mu, and Mv, refer to their respective series.)	48–76	0–76	Loam	ML	A-4
Midway:					
Mw, My (For properties of the Razor soil in Mw, refer to the Razor series. Shale outcrop in My not rated.)	10–20	0–12 12	Heavy clay loam Shale.	CL or CH	A–6 or A–7
Oburn:					
Oh, Os (For properties of Shaak soil in these units, refer to the Shaak series.)	>60	0–36 36–60	Clay Very gravelly sandy loam	CH GW-GM	A–7 A–1
Pierre:					
Pc, Pl (For properties of Lismas soil in Pl, refer to the Lismas series.)	20–40	0–24 24	Clay Shale.	ML-CL or CH	A-7
Razor:					
Ra, Rc (For properties of the Cushman soil in Rc, refer to the Cushman series.)	20–40	0–29 29	Clay loam Shale.	CL	A–6
Ryegate:					
Rn, Rr, Rt (For properties of Travessilla soil in Rr and Rt, refer to the Travessilla series.)	20–40	0–25 25	Sandy clay loam Indurated sandstone.	SC	A–6
Sage:					
Sa	>60	0–60	Clay	CH	A-7
Shaak:					
Sh, Sk	>60	0–40 40–56	Silty clay or clay loam Gravelly sandy loam	CH GM	A-7 A–2

properties of soils—Continued

Percentage passing sieve—			Permeability in place	Available[2] water capacity	Reaction	Salinity	Corrosivity of untreated steel pipe	Shrink-swell potential	Frost-action potential
No. 4	No. 10	No. 200							
			Inches per hour	*Inches per inch of soil*	*pH*				
100	95	65–85	0. 63–2. 0	0. 16–0. 18	6. 6–7. 3	None	Moderate	Moderate	Moderate.
--------	100	80–100	0. 06–0. 20	0. 14–0. 16	7. 4–8. 4	None	High	High	Moderate.
--------	100	80–90	0. 2–0. 63	0. 14–0. 16	7. 9–8. 4	None	High	High	Moderate.
--------	100	40–50	2. 0–6. 3	0. 12–0. 14	7. 9–9. 0	Low to high	Moderate to high.	Low	High.
--------	100	80–100	0. 06–0. 2	0. 14–0. 16	7. 9–8. 4	None to low	High	High	Moderate.
30–50	15–35	0–10	>20	0. 03–0. 05	7. 4–7. 8	None to low	Low to moderate.	Low	Low.
25–55	20–50	5–20	0. 2–0. 63	0. 06–0. 08	6. 1–6. 5	None	Low	Low	Low.
--------	100	90–100	<0. 06	0. 14–0. 16	7. 9–9. 5	Moderate to high.	High	High	Moderate.
--------	100	60–75	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	None	Low	Low	High.
--------	100	80–90	0. 06–0. 20	0. 16–0. 18	7. 9–8. 4	None	Moderate	High	Moderate.
--------	100	80–95	0. 06–0. 2	0. 14–0. 16	7. 4–9. 0	None	High	High	Moderate.
25–35	20–30	5–15	6. 3–20. 0	0. 05–0. 07	7. 9–9. 0	Low to moderate.	Moderate to high	Low	Low.
95–100	90–100	85–95	0. 06–0. 20	0. 14–0. 16	7. 9–8. 4	Low to moderate.	High	High	Moderate.
--------	100	70–90	0. 2–0. 63	0. 18–0. 20	7. 4–8. 4	Low to high	Moderate to high.	Moderate	Moderate.
100	90–100	40–50	0. 2–0. 63	0. 14–0. 16	6. 6–7. 4	None	Moderate	Moderate	Moderate.
--------	100	90–100	>0. 06	0. 14–0. 16	8. 5–9. 2	Very high	High	High	Moderate.
95–100	90–95	75–85	0. 06–0. 20	0. 15–0. 17	6. 6–8. 4	None to low	High	High	Moderate.
50–60	40–50	20–30	2. 0–6. 3	0. 08–0. 10	7. 9–8. 4	Moderate	High	Low	Low.

TABLE 4.—*Estimated engineering*

Soil series and map symbol	Depth to hard bedrock	Depth from surface	Classification		
			Dominant USDA texture	Unified	AASHO
	Inches	*Inches*			
Shonkin: Sn	>60	0–9	Loam	ML	A–4
		9–32	Clay	CH	A–7
		32–62	Clay loam	CL	A–6
Shorey: So, Sr	>60	0–64	Stratified gravelly loam and loam.	GM	A–2 or A–4
Thurlow: Ta, Tc	>60	0–60	Clay loam	CL	A–6
Toluca: Te, Th, Tm, Tn, To (For properties of the Wanetta soil in Tn and To, refer to the Wanetta series.)	>60	0–35	Loam or clay loam	ML or CL	A–4 or A–6
		35–60	Very gravelly loam to gravelly sand.	GM	A–2
Travessilla: Tr, Ts, Tt	10–20	0–10	Loam or sandy loam	ML to SM	A–4
		10	Sandstone.		
Treasure: Tu, Tw	>60	0–16	Sandy clay loam	SC	A–6
		16–60	Sandy loam and loam	SM	A–2 or A–4
Vananda: Va, Vd, Ve (For properties of the Bone soil in Vc, refer to the Bone series.)	>60	0–62	Clay	CH	A–7
Wanetta: Wa, Wc, We, Wf, Wg, Wh, Wk, Wl (For properties of Larim soil in Wh, Wk, and Wl, refer to the Larim series.)	>60	0–26	Clay loam and some gravel	ML or CL	A–4 or A–6
		26 60	Very gravelly sand	GW or SW	A–1
Work: Wm, Wn	>60	0 61	Clay loam	ML to CL	A–4 or A–6
Worland: Wo, Wr (For properties of Travessilla soil in Wr, refer to the Travessilla series.)	20–40	0–30	Fine sandy loam	SM	A–4
		30–40	Very gravelly sandy loam	SM	A–2
		40	Sandstone.		
Wormser: Ws, Wt, Wv, Ww (For properties of Lavina soil in Wv and Worland soil in Ww, refer to their respective series.)	20–40	0–34	Clay loam	ML or CL	A–4 or A–6
		34	Sandstone and shale.		
Yegen: Ya, Yd, Ye, Yt (For properties of Toluca soil in Yt, refer to the Toluca series.)	>60	0–23	Sandy clay loam	ML to CL	A–6 or A–4
		23–64	Sandy loam	SM	A–2 or A–4

properties of soils—Continued

Percentage passing sieve— No. 4	Percentage passing sieve— No. 10	Percentage passing sieve— No. 200	Permeability in place	Available water capacity	Reaction	Salinity	Corrosivity of untreated steel pipe	Shrink-swell potential	Frost-action potential
			Inches per hour	*Inches per inch of soil*	*pH*				
--------	100	70–90	0. 63–2. 0	0. 16–0. 18	6. 1–6. 5	None	Low	Low	High.
--------	100	80–90	0. 06–0. 20	0. 14–0. 16	6. 6–7. 8	None	High	High	Moderate.
--------	100	85–95	0. 2–0. 63	0. 18–0. 20	7. 9–8. 4	None	Moderate	Moderate	Moderate.
50–90	35–75	25–45	0. 63–2. 0	0. 09–0. 11	7. 4–8. 4	None	Low	Low	Moderate.
100	100	80–90	0. 2–0. 63	0. 18–0. 20	6. 6–8. 4	None	Moderate	Moderate	Moderate.
90–100	80–90	70–80	0. 63–2. 0	0. 17–0. 19	6. 6–8. 4	None	Low to moderate.	Moderate	Moderate to high.
35–45	30–40	15–25	2. 0–6. 3	0. 06–0. 08	7. 9–8. 4	None	Low	Low	Low.
80–100	75–100	35–70	0. 63–2. 0	0. 10–0. 14	6. 6–7. 3	None	Low	Low	Moderate to high.
100	90–100	35–50	0. 63–2. 0	0. 14–0. 16	6. 6–7. 3	None	Moderate	Moderate	Moderate.
100	90–100	30–40	0. 63–2. 0	0. 12–0. 14	7. 9–8. 4	None	Low	Low	Moderate.
--------	100	90–100	<0. 06	0. 14–0. 16	8. 5–9. 2	Moderate to high.	High	High	Moderate.
80–100	75–95	60–80	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	None	Moderate	Moderate	Moderate.
25–55	20–50	0–5	>20	0. 03–0. 05	7. 9–8. 4	None	Low	Low	Low.
90–100	90–95	70–85	0. 2–0. 63	0. 18–0. 20	6. 6–8. 4	None	Moderate	Moderate	Moderate.
100	90–100	35–45	2. 0–6. 3	0. 12–0. 14	7. 9–8. 4	None	Low	Low	Moderate.
15–35	10–30	5–15	2. 0–6. 3	0. 05–0. 07	7. 9–8. 4	None	Low	Low	Very low.
95–100	90–100	75–85	0. 2–0. 63	0. 18–0. 20	6. 6–8. 4	None	Moderate	Moderate	Moderate.
90–100	90–100	50–60	0. 2–0. 63	0. 14–0. 16	6. 1–7. 3	None	Moderate	Moderate	Moderate.
95–100	90–100	30–40	2. 0–6. 3	0. 11–0. 13	7. 4–8. 4	None	Low	Low	Low.

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TABLE 5.—*Interpretations of*

[Absence of interpretations indicates that the practice

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Absarokee: Aa, Ab	Good to a depth of 10 inches.	Unsuitable	Unsuitable	Poor: low dry density; medium plasticity; low shear strength; low bearing capacity.	High compressibility; moderately slow permeability; moderate frost-action potential; medium plasticity.	Shale bedrock at a depth of 20 to 40 inches.	Low dry density; moderate to low stability; moderate shrink-swell potential.
Allentine (Mapped only with Bew, Gilt Edge, and Hydro soils in complexes.)	Poor: material too clayey.	Unsuitable	Unsuitable	Poor: low dry density; impervious when compacted; low shear strength; high shrink-swell potential.	High compressibility and elasticity; slow permeability; not a source of good construction material.	Features generally favorable.	Low dry density; low stability; high shrink-swell potential.
Alluvial land, gravelly: Ag	Poor: material too gravelly.	Good to fair: not well graded on small stream terraces; screening required to remove gravel.	Good: well-graded material; thickness varies on small stream terraces.	Good: high dry density; high shear strength; good workability.	Occasional flooding.	Porous material.	Porous material; high gravel content.
Alluvial land, mixed: Al	Poor: material too variable.	Good: well-graded sand and gravel; screening required to remove gravel; overburden is 0 to 60 inches thick.	Good: well-graded material; water table at a depth of 36 to 72 inches on river terraces.	Good: no unfavorable features.	Occasional flooding; water table at a depth of 36 to 72 inches on river terraces.	Porous substratum.	Porous material; high gravel content.
Alluvial land, seeped: Am	Fair	Unsuitable	Unsuitable	Poor: high organic-matter content; poor workability; moderate bearing capacity.	High water table; high frost-action potential.	Features generally favorable.	High organic-matter content; medium to high compressibility; low dry density; poor compaction; high water table.

engineering properties

or use is not applicable or is not needed]

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
------------	------------	------------	Uneven slopes; shale bedrock at a depth of 20 to 40 inches.	Clay subsoil	Medium to low bearing capacity; moderate shrink-swell potential; high compressibility; shale at a depth of 20 to 40 inches.	Severe: moderately slow permeability; slow hydraulic conductivity and percolation rate.	Severe: depth to bedrock less than 40 inches.
Slow permeability; slow hydraulic conductivity and percolation rate.	Poor workability; dense clay subsoil.	Slow permeability and intake rate.	Slow permeability and intake rate; unstable in embankments.	Rapid runoff; slow permeability.	Low bearing capacity; high shrink-swell potential; high compressibility; slow permeability.	Severe: slow permeability; slow hydraulic conductivity and percolation rate.	Slight: slopes.
------------	------------	------------	------------	------------	Features generally favorable.	Severe: seasonal water table; flooding.	Severe: rapid permeability.
Occasional flooding; difficult to obtain suitable outlets or stable ditchbanks on river terraces.	------------	Uneven slopes; wide range in permeability.	------------	------------	Occasional flooding; seasonal water table within 72 inches of the surface.	Severe: flooding; high seasonal water table.	Severe: flooding hazard.
------------	------------	------------	------------	------------	Seasonal high water table; low shear strength; low bearing capacity.	Severe: high seasonal ground water level; soil saturated most of year.	Severe: high water table.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as a source of— Topsoil	Sand	Gravel	Road fill	Soil features affecting— Highway location	Farm ponds: Reservoir area	Farm ponds: Embankment
Alluvial land, wet: An	Fair	Poor	Poor	Poor: poor workability; fair to poor source of fill material.	Water table at or within 36 inches of surface.	High water table.	High compressibility; low stability.
Amherst: Ao, Ap (For interpretations of the Magninis soil in Ap, refer to the Magninis series.)	Fair to a depth of 6 inches if surface stones are removed.	Unsuitable	Unsuitable	Poor: low dry density; medium plasticity; low shear strength; low bearing capacity.	Indurated sandstone at a depth of less than 20 inches; not a source of good construction material.	Shattered bedrock at a depth of less than 20 inches.	Low dry density; high content of stones and organic matter; moderate permeability.
Apron: Ar, As, At (For interpretations of the Travessilla soil in At, refer to the Travessilla series.)	Poor: material too sandy; high erodibility.	Unsuitable	Unsuitable	Good to fair: high dry density; high shear strength; subject to piping.	High risk of erosion on exposed banks.	Rapid permeability; requires compacted soil blanket.	Fair stability; moderate permeability in compacted embankments; subject to piping.
Arvada: Au, Av, Aw, Ax, Ay. (For interpretations of the Bone soil in Ax and Ay, refer to the Bone series.)	Unsuitable	Poor	Poor: overburden 48 inches thick on river terraces; not suitable in other places.	Poor: high dispersion, high shrink-swell potential; high susceptibility to piping; high erodibility.	High dispersion; low stability; very slow permeability.	Features generally favorable.	Low dry density; unstable slopes; high volume change.
Bainville: Bb, Bc, Bl (For interpretations of the Worland soil in Bl, refer to the Worland series.)	Fair: low fertility.	Unsuitable	Unsuitable	Poor: low shear strength; poor compaction; high frost-action potential.	Siltstone at a depth of 20 to 40 inches; highly erodible slopes; high frost-action potential; not a source of good construction material.	Features generally favorable.	Low dry density; low shear strength; high erodibility; poor compaction.

engineering properties—Continued

Soil features affecting—*Continued*						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
----------	----------	----------	----------	----------	Water table at or near surface most of time.	Severe: water table at or near surface most of time.	Severe: flooding hazard.
----------	----------	----------	Uneven slopes; moderate stability; sandstone and shale at a depth of less than 20 inches.	Bedrock at a depth of less than 20 inches.	Low bearing capacity; low to moderate shrink-swell potential; shale at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.	Severe: bedrock at a depth of less than 20 inches.
----------	----------	----------	High risk of erosion; subject to piping in embankments.	Low available water capacity.	Features generally favorable.	Slight to moderate where slopes are 4 to 10 percent; severe where slopes are 10 to 15 percent.	Severe: rapid permeability.
Very slow permeability; high dispersion; unstable ditchbanks; high corrosivity.	High dispersion; salts near the surface.	Very slow permeability; high dispersion; moderate to severe risk of erosion; slopes of 1 to 7 percent.	Unstable slopes; high risk of erosion; low fertility.	High risk of erosion; difficult to establish vegetation because of high salinity and alkalinity.	High dispersion; high shrink-swell potential; low bearing capacity; very slow permeability.	Severe: very slow permeability; high dispersion; slow hydraulic conductivity and percolation rate.	Slight where slopes are 0 to 1 percent; moderate where slopes are 1 to 7 percent.
----------	----------	----------	Siltstone at a depth of 20 to 40 inches; highly erodible; low stability in embankments.	High risk of erosion; moderate permeability.	High frost-action potential; siltstone at a depth of 20 to 40 inches; low bearing capacity; high compressibility; very low shear strength.	Severe: siltstone at a depth of 20 to 40 inches; moderate permeability; moderately steep slopes.	Moderate to severe: moderately steep slopes.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Bainville—Continued Be, Bf, Bg (For interpretations of the Elso soil in Be and Bf, and Shale outcrop in Bf, refer to the Elso series and Shale outcrop. Rock outcrop in Bg not interpreted.)	Fair: low fertility.	Unsuitable	Unsuitable	Poor: low shear strength; poor compaction; high frost-action potential.	Steep slopes, rough broken topography, or both; siltstone or bedrock at a depth of 5 to 30 inches; unstable slopes; not a source of good construction material.	Features generally favorable.	Low dry density; low shear strength; high erodibility; poor compaction.
Bew: Bm, Bn, Bo Br (For interpretations of the Allentine soil in Br, refer to the Allentine series).	Poor: high clay content.	Unsuitable	Unsuitable	Poor: low dry density; high volume change; slow permeability; unstable slopes.	High compressibility and expansion; high elasticity; high shrink-swell potential; slow permeability; moderate frost-action potential.	Features generally favorable.	Low dry density; poor compaction; high shrink-swell potential.
Big Horn: Bs	Fair to a depth of 7 inches; poor below.	Unsuitable	Unsuitable	Fair to poor: low dry density; moderate volume change.	Moderate compressibility; high shrink-swell potential; moderate frost-action potential.	Features generally favorable.	Low dry density; moderate compaction; high shrink-swell potential.
Bone: Bt, Bu, Bv	Unsuitable	Unsuitable	Unsuitable	Unsuitable	High compressibility and expansion; high shrink-swell potential; moderate frost-action potential; very slow permeability.	Features generally favorable.	Low dry density; high dispersion; high shrink-swell potential; poor compaction.
Clapper: Ca	Unsuitable	Unsuitable	Poor: high content of calcareous fines; requires washing and screening.	Good: medium dry density.	Except for steep slopes, no unfavorable features.	Strongly sloping to moderately steep slopes; erodible outlets.	Medium dry density; moderate permeability in compacted fill.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
----------	----------	----------	----------	----------	High frost-action potential; siltstone at a depth of 20 to 40 inches; low bearing capacity; high compressibility; very low shear strength.	Severe: steep slopes.	Severe: steep slopes.
Slow permeability; slow hydraulic conductivity and percolation rate.	Features generally favorable.	Slow permeability.	Poor workability.	Slow permeability.	Low bearing capacity; high shrink-swell potential; slow permeability; high compressibility.	Severe: slow permeability; slow hydraulic conductivity and percolation rate.	Slight: slopes.
----------	----------	----------	Moderately slow permeability and slow intake rate; unstable in embankments.	Moderately slow permeability; rapid runoff.	Medium bearing capacity; high shrink-swell potential; moderate frost-action potential.	Severe: moderately slow permeability.	Slight: slopes of 1 to 2 percent.
Very slow permeability; high dispersion; unstable in ditchbanks.	Poor workability; high dispersion; high salinity and alkalinity.	Very slow permeability; high salinity and alkalinity.	Low stability; poor compaction.	Clay texture; high salinity; high dispersion; high erodibility; difficult to establish vegetation.	Low bearing capacity; high shrink-swell potential.	Severe: very slow permeability.	Moderate: slopes.
----------	----------	----------	----------	----------	Except for steep slopes, no unfavorable features.	Severe: steep slopes in places.	Severe: contains more than 20 percent coarse fragments; slopes of more than 7 percent.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Clapper—Continued Cg	Unsuitable	Unsuitable	Poor: high content of calcareous fines; requires washing and screening.	Good: medium dry density.	Features generally favorable.	Strongly sloping to moderately steep slopes; erodible outlets.	Medium dry density; moderate permeability in compacted fill.
Cushman: Ch, Cm (For interpretations of the Bainville soil in these units, refer to the Bainville series.)	Good to a depth of 12 inches.	Unsuitable	Unsuitable	Fair to poor: sandstone or shale at a depth of 20 to 40 inches; low shear strength.	Medium compressibility; erodible slopes; moderate to high frost-action potential; sandstone or shale at a depth of 20 to 40 inches.	Features generally favorable.	Low dry density; moderate shear strength; high erodibility; subject to piping.
Danvers: Da, Dn, Dr, Ds (For interpretations of the Judith soil in Dr and the Shaak soil in Ds, refer to their respective series.)	Good to a depth of 6 inches; poor below; too clayey and too limy.	Poor: overburden is 48 to 60 inches thick; screening required to remove gravel.	Poor: mixed sand, gravel, and silt at a depth of 48 to 60 inches; requires washing and screening.	Poor: low dry density; moderate volume change; unstable slopes.	High compressibility; highly erodible slopes; moderate frost-action potential.	Moderately slowly permeable substratum.	Low dry density; fair to poor compaction; moderate frost-action potential.
Elso: Ec, El	Unsuitable	Unsuitable	Unsuitable	Poor: low shear strength; poor compaction.	Shale at a depth of 10 to 20 inches; medium compressibility; highly erodible slopes; moderate to high frost-action potential.	Features generally favorable.	Low shear strength; low dry density; highly erodible; subject to piping.
Eo, Es (For interpretations of the Lohmiller soil in Es, refer to the Lohmiller series.)	Unsuitable	Unsuitable	Unsuitable	Poor: low shear strength; poor compaction.	Steep slopes, rough broken topography, or both; shale at a depth of 10 to 20 inches; highly erodible slopes.	Features generally favorable.	Low shear strength; low dry density; highly erodible; subject to piping.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
------------	------------	Moderately steep, uneven slopes; moderate risk of erosion.	Moderately steep, uneven slopes; moderate risk of erosion; unstable in embankments.	Low available water capacity; low fertility; moderate risk of erosion.	Except for steep slopes, no unfavorable features.	Severe: steep slopes in places.	Severe: slopes of more than 7 percent.
------------	------------	------------	Sandstone or shale at a depth of 20 to 40 inches; unstable in embankments.	Moderate available water capacity.	Low bearing capacity; low to moderate shrink-swell potential; sandstone or shale at a depth of 20 to 40 inches; moderate compressibility; moderate to high frost-action potential.	Severe: sandstone or shale at a depth of 20 to 40 inches; moderately slow permeability.	Moderate: slopes.
------------	------------	------------	Features generally favorable.	Deep cuts expose highly erodible calcareous substratum.	Medium bearing capacity; high shrink-swell potential.	Severe: moderately slow permeability and percolation rate; high dispersion potential in lime horizon.	Moderate for Da; severe for Dn, Dr, and Ds: slopes and slowly permeable substratum.
------------	------------	------------	Siltstone at a shallow depth; uneven, moderately steep slopes.	Deep cuts expose raw shale; moderately steep, erodible slopes; low available water capacity.	Medium bearing capacity; moderate shrink-swell potential; moderate compressibility; poor stability; steep slopes.	Severe: shale at a depth of 10 to 20 inches; steep slopes.	Severe: steep slopes.
------------	------------	------------	Steep slopes	Steep slopes	Medium bearing capacity; moderate shrink-swell potential; moderate compressibility; poor stability; steep slopes.	Severe: shale at a depth of 10 to 20 inches; steep slopes.	Severe: steep slopes.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds: Reservoir area	Farm ponds: Embankment
Farland: Fa (For interpretations of the Lambert soil in this unit, refer to the Lambert series.)	Good to a depth of 10 inches.	Unsuitable	Unsuitable	Poor: high frost-action potential; low shear strength; high susceptibility to piping.	Moderate compressibility and expansion; high frost-action potential; highly erodible embankments; not a source of good construction material.	Moderate permeability.	Low dry density; highly erodible; subject to piping; poor stability.
Fattig: Fg	Good: high organic-matter content.	Unsuitable	Unsuitable	Poor: high organic-matter content; moderate volume change; impervious when compacted; sub ect to piping.	Medium compressibility; moderate frost-action potential; low bearing capacity; siltstone or other rock at a depth of 20 to 40 inches; not a source of good construction material.	Features generally favorable.	Moderate shear strength; low dry density; high organic-matter content; low stability.
Fort Collins: Fl, Fo, Fr, Ft (For interpretations of the Arvada soil in Fl and Fo and Thurlow soil in Fr and Ft, refer to their respective series.)	Good	Unsuitable	Gravel at a depth of 48 inches on some terraces.	Fair to poor: moderate to high frost-action potential; low shear strength; very susceptible to piping and erosion.	Medium to high compressibility and expansion; low bearing capacity; not a source of good construction material.	Moderately slow permeability; slopes of 1 to 4 percent.	Medium shear strength; low to moderate erodibility; low stability.
Gilt Edge: Ga (For interpretations of the Allentine soil in this unit, refer to the Allentine series.)	Good to a depth of 6 to 8 inches.	Unsuitable	Unsuitable	Poor: low dry density; high volume change.	Not a source of good construction material; high compressibility and expansion; low bearing capacity; high shrink-swell potential; slow permeability; bedrock at a depth of 20 to 40 inches.	Features generally favorable.	Low shear strength; high volume change; low dry density; poor compaction.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
----------------	----------------	----------------	Highly erodible substratum; unstable in embankments.	Deep cuts expose erodible calcareous substratum.	Very low bearing capacity; high frost-action potential; high compressibility or consolidation.	Slight to moderate: moderate permeability.	Slight: slopes.
----------------	----------------	----------------	Uneven slopes; moderate risk of channel erosion.	Erodible soil--	Moderate to high compressibility; low bearing capacity.	Severe: bedrock at a depth of 20 to 40 inches; moderately slow permeability.	Moderate: slopes.
Moderately slow permeability; silt and fine sand content reduces effectiveness of tile; unstable ditchbanks.	Features generally favorable.	Features generally favorable for Fl and Fr; moderate risk of erosion for Fo and Ft.	Features generally favorable for Fl and Fr; moderate risk of erosion and low stability for Fo and Ft.	Features generally favorable.	Medium to high compressibility; low bearing capacity.	Severe: moderately slow permeability.	Moderate: slopes; moderately slow permeability.
----------------	----------------	----------------	High volume change; poor workability.	Clay subsoil; difficult to establish vegetation.	Low bearing capacity; high shrink-swell potential; shale at a depth of 20 to 40 inches; slow permeability.	Severe: slow permeability; shale at a depth of 20 to 40 inches.	Moderate: slopes.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Glenberg: Gh, Gi	Fair: subject to sand blowing.	Fair to poor: overburden more than 48 inches thick on river terraces.	Fair: well-graded gravel below a depth of 48 inches in most places.	Fair: fair stability; impervious when compacted; high susceptibility to piping.	Water table on river terraces; low compressibility; moderate to high frost-action potential; high risk of erosion on exposed banks.	Moderately rapid permeability; porous substratum.	Fair stability; moderate permeability in compacted embankments; high susceptibility to erosion and piping.
Go	Fair: subject to sand blowing.	Fair: well-graded sand and gravel at a depth of 20 to 40 inches.	Good: well-graded gravel and sand at a depth of 20 to 40 inches.	Fair: fair stability; impervious when compacted; high susceptibility to piping.	Features generally favorable.	Porous below a depth of 20 inches.	Limited source of good construction material.
Grail: Gr, Gs, Gt	Fair to poor: material too clayey.	Unsuitable	Unsuitable	Fair to poor: low shear strength; moderate frost-action potential; high volume change; impervious when compacted.	Not a source of good construction material; moderate compressibility and expansion; moderate frost-action potential; high shrink-swell potential; slow permeability.	Features generally favorable.	Medium to low dry density; high volume change; fair compaction; low shear strength; low stability.
Haverson: Ha, Hb, Hc, Hd, He, Hh, Hl, Hm. (For interpretations of the Hysham soil in Hh and the Lohmiller soil in Hl and Hm, refer to their respective series.)	Good	Fair to good	Fair to good	Fair to poor	Moderate frost-action potential.	Moderate permeability.	Poor stability; poor compaction; high erodibility; subject to piping.
Hn	Good	Good: well-graded sand and gravel below a depth of 20 inches.	Good: well-graded gravel and sand below a depth of 20 inches.	Fair to poor	Features generally favorable.	Porous below a depth of 20 inches.	Poor stability; poor compaction; limited source of good construction material.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
Unstable ditchbanks.	Subject to soil blowing.	High risk of erosion in sloping areas.	Moderate risk of erosion in sloping areas; unstable embankments.	Moderate risk of erosion; moderately low available water capacity; moderately rapid permeability.	Features generally favorable.	Slight	Severe: moderately rapid permeability; porous substratum.
Features generally favorable.	Shallow to sand and gravel.	Moderately low available water capacity.			Features generally favorable.	Slight	Severe: moderately rapid permeability.
Slow permeability; unstable ditchbanks; slow hydraulic conductivity and percolation rate.	Poor workability.	Slow permeability and intake rate.	No unfavorable features for Gr and Gs; moderate to high risk of erosion, slow permeability and intake rate, and uneven, steep slopes for Gt.	Moderate risk of erosion for Gr and Gs; slow permeability and intake rate and high risk of erosion for Gt.	Low bearing capacity; low shear strength; slow permeability; high shrink-swell potential; moderate frost-action potential.	Severe: slow permeability; slow hydraulic conductivity and percolation rate.	Moderate to severe: slopes.
Moderate permeability; unstable ditchbanks for all except Hb; slow permeability below a depth of 20 to 40 inches for Hb.	Features generally favorable.	Features generally favorable.	High erodibility.	Moderate to high risk of erosion on slopes greater than 1 percent.	Low shear strength; medium bearing capacity; medium compressibility.	Slight to moderate for all except Hb; moderate permeability; severe for Hb; slowly permeable substratum.	Slight on slopes of less than 4 percent; severe on slopes of more than 7 percent.
Features generally favorable.	Deep cuts may expose sand and gravel.	Features generally favorable.			Features generally favorable.	Slight	Severe: contains more than 50 percent coarse fragments.

TABLE 5. —*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Heldt: Ho	Good to a depth of 12 inches.	Unsuitable	Unsuitable	Fair to poor: moderately high dry density; low shear strength.	Moderate compressibility and expansion; high capillarity; moderate frost-action potential.	Slopes of 4 to 7 percent.	Moderately high dry density; high volume change; low shear strength.
Hesper: Hp, Hr	Good to a depth of 5 inches; poor below.	Poor: overburden is 48 to 72 inches thick; screening required to remove gravel.	Fair to poor: well-graded sand and gravel at a depth of 48 inches in some places.	Fair to poor: moderate dry density; high frost-action potential; fair compaction; high content of fines.	Medium compressibility and expansion; fair to poor bearing capacity; high erodibility in embankments; high frost-action potential.	Moderately slow permeability; porosity increases with depth.	Poor stability; poor compaction; moderate permeability in compacted embankments; moderate dry density; high erodibility; subject to piping.
Hilly gravelly land: Hs	Unsuitable	Good: well-graded sand and gravel below a depth of 6 to 15 inches; screening required to remove gravel.	Good: well-graded sand and gravel at a depth of 6 to 15 inches.	Good: high stability; rapid permeability on compacted fill.	Features generally favorable.	Soil material too porous.	High gravel and sand content; very pervious in fills.
Hopley: Ht	Good to a depth of 10 inches; fair below.	Unsuitable	Unsuitable	Fair to good: moderate shear strength; moderate compressibility; high frost-action potential.	Unstable embankments; high erodibility; high frost-action potential; shale at a depth of 36 to 60 inches.	Moderate permeability; may require impervious soil blanket.	Poor stability and compaction; moderate permeability when compacted; subject to piping.
Hovert: Hu	Unsuitable	Unsuitable	Unsuitable	Poor: low dry density; high volume change; high plasticity; poor workability.	High compressibility and expansion; high elasticity; high volume change; moderate frost-action potential; slow permeability; subject to ponding.	Features generally favorable.	Low dry density; high shrink-swell potential; high compressibility in compacted embankments.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
Slow permeability.	Features generally favorable.	Moderate slopes.	Moderate slopes.	Moderate slopes.	Low bearing capacity; low shear lstrength.	Severe: slow permeability.	Moderate: slopes.
Moderately slow permeability; unstable ditchbanks; silt and sand content reduces effectiveness of tile.	Features generally favorable.	Uneven, erosive slopes in some places; moderate *risk* of erosion.	Highly erodible substratum.	Erodible substratum exposed by deep cuts.	Low bearing capacity; medium compressibility; high frost-action potential; some consolidation when wet.	Severe: moderately slow permeability.	Moderate: slopes of more than 2 percent.
------	------	------	------	------	Features generally favorable.	Severe: modately steep slopes.	Severe: slopes.
------	------	------	Uneven slopes; high risk of erosion.	Slopes of 4 to 7 percent; high risk of erosion.	Low bearing capacity; moderate permeability; shale at a depth of 36 to 60 inches.	Moderate: moderate permeability; slopes of 4 to 7 percent.	Moderate: slopes.
------	------	------	------	------	Subject to ponding; low bearing capacity; high shrink-swell potential; high compressibility.	Severe: slow permeability; surface ponding.	Moderate: flooding hazard.

TABLE 5.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Hydro: Hv, Hw (For interpretations of the Allentine soil in Hv and the Arvada soil in Hw, refer to their respective series.)	Fair to a depth of 8 inches; poor below; clayey.	Unsuitable	Unsuitable	Poor: low dry density; high volume change; low shear strength.	High compressibility and expansion; high elasticity; slow permeability.	Features generally favorable.	Low dry density; high shrink-swell potential; low stability.
Hysham: Hx, Hy, Hz (For interpretations of the Laurel soil in Hx and Hy and the Haverson soil in Hz, refer to their respective series.)	Unsuitable	Poor: well-graded sand and gravel below a depth of 55 inches on river terraces only.	Poor: well-graded sand and gravel at a depth of 55 inches on river terraces only.	Poor: high dispersion; impervious compacted fill; low stability; strong salinity.	Low bearing capacity; low shear strength; medium compressibility; high frost-action potential; unstable slopes.	Features generally favorable.	Low stability; low dry density; high erodibility; high dispersion; subject to piping; strong salinity.
Judith (Mapped only with Danvers soil in a complex.)	Good to a depth of 8 inches; unsuitable below; too limy.	Unsuitable	Poor: very thick overburden; too many fines.	Poor: poor compaction; moderate frost-action potential; low dry density; susceptible to piping.	Limited source of good construction material; high compressibility.	Very gravelly substratum.	Low stability; low dry density; poor compaction; subject to piping and erosion.
Keiser: Kc, Ke, Kg, Kh (For interpretations of the Hesper soil in Kh, refer to the Hesper series.)	Good to a depth of 10 inches; fair to poor below.	Poor: overburden is 48 to 72 inches thick; screening required to remove gravel.	Fair: well-graded sand and gravel below a depth of 40 inches in some places.	Fair to poor: moderate dry density; high frost-action potential; fair compaction.	Medium compressibility and expansion; low bearing capacity; high erodibility in embankments.	Moderately slow permeability; porosity increases with depth.	Poor stability; poor compaction; moderately slow permeability in compacted embankments; subject to piping.
Kyle: Kl, Km, Kn	Poor: material too clayey.	Unsuitable	Unsuitable	Poor: low dry density; high volume change; slow permeability; unstable slopes.	High compressibility and expansion; high elasticity; high shrink-swell potential; slow permeability; moderate frost-action potential.	Features generally favorable.	Low dry density; poor compaction; poor stability.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
Slow permeability.	Cuts expose clayey subsoil.	Slow permeability and intake rate.	Poor workability; uneven slopes; slow permeability.	Slow permeability and intake rate; clayey subsoil.	Low bearing capacity; high shrink-swell potential; high compressibility; slow permeability.	Severe: slow permeability.	Moderate: slope.
Slow permeability; high dispersion.	Leveling may expose strongly alkaline substratum; poor workability.	Slow permeability and intake rate; high dispersion; crusty surface.	Unstable embankments; high dispersion; low stability; slow permeability and intake rate.	High dispersion; strong salinity; difficult to establish vegetation; slow permeability and intake rate.	Low bearing capacity; low shear strength; slow permeability; high frost-action potential.	Severe: slow permeability; high dispersion.	Slight: slopes.
------------	------------	------------	Shallow to very limy soil; very gravelly substratum; strong slopes; moderate risk of erosion.	Moderate risk of erosion; low fertility; high lime content below a depth of 8 to 12 inches.	Moderate to high compressibility; moderate frost-action potential.	Severe: strong slopes; high dispersion potential.	Moderate to severe: strong slopes; contains coarse fragments.
Moderately slow permeability; unstable ditchbanks; silt and fine sand reduce effectiveness of tile.	Leveling exposes very limy material.	Features generally favorable for Kc and Kh; risk of erosion moderate for Kc and severe for Kg.	Cuts expose very limy material; moderate to severe risk of erosion.	Cuts expose very limy material; moderate to severe risk of erosion.	Low bearing capacity; medium compressibility; high frost-action potential.	Severe: moderately slow permeability.	Slight to moderate: slopes.
Slow permeability.	Moderate slopes.	Slow permeability and intake rate; moderate slopes.	Slow permeability and intake rate; unstable embankments.	Slow permeability and intake rate; clay texture.	Low bearing capacity; low shear strength; high shrink-swell potential; slow permeability.	Severe: slow permeability.	Moderate: slopes.

TABLE 5—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Lambert: La, Lb, Lc, Ld	Good	Unsuitable	Unsuitable	Poor: moderate dry density; fair to poor compaction; high frost-action potential.	High compressibility; low bearing capacity; high erodibility in deep cuts; high frost-action potential; moderate to high risk of erosion for Lb, Lc, and Ld.	Moderately slow permeability; may require compacted soil blanket.	Poor stability; poor compaction; high erodibility; subject to piping.
Larim: Le, Lg, Lh, Ll	Poor: surface gravel.	Good: well-graded sand and gravel below a depth of 20 inches; screening required to remove gravel.	Good: well-graded sand and gravel at a depth of 20 inches.	Good: high shear strength; good compaction.	Features generally favorable.	Substratum very porous.	Shallow depth of usable material; stones throughout.
Laurel: (Mapped only with Hysham soils in complexes.)	Unsuitable	Unsuitable	Poor: water table in underlying gravel on river terraces.	Poor: very high salinity; high dispersion; poor compaction; high erodibility.	Low bearing capacity; moderate frost-action potential; unstable slopes; high seasonal water table; high dispersion.	Porous substratum below a depth of 48 inches; very high salinity.	Low stability; low dry density; high erodibility; high dispersion; subject to piping; very high salinity.
Lavina: Lm	Good to a depth of 6 inches; poor below.	Unsuitable	Unsuitable	Moderate frost-action potential; moderate shear strength; moderate bearing capacity.	Indurated sandstone at a depth of less than 20 inches; not a source of good construction material.	Shallow to bedrock.	Bedrock at a depth of 8 to 20 inches; fair compaction; medium dry density and volume change.
Lismas: Ln	Unsuitable	Unsuitable	Unsuitable	Unsuitable	High compressibility and expansion; high shrink-swell potential; slow permeability; low stability; not a source of good construction material.	Features generally favorable.	Low dry density; low shear strength; high volume change; poor workability.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
Moderately slow permeability; unstable ditchbanks; silt content reduces effectiveness of tiles.	Features generally favorable.	Erosion hazard slight to moderate for La and Lb and moderate to high for Lc and Ld.	Low stability; moderate risk of erosion.	Strong to moderately steep slopes; moderate risk of erosion.	Low bearing capacity; high compressibility; high frost-action potential; moderately steep to steep.	Severe: poorly graded materials; moderately slow permeability.	Moderate to severe: slopes of more than 7 percent.
----------	Leveling exposes sand and gravel at a depth of 20 inches.	Very rapid permeability below a depth of 20 inches; uneven surface.	Shallow soil; very porous substratum; low available water capacity.	Deep cuts expose the infertile substratum; steep, erodible slopes.	Features generally favorable for Le, Lg, and Lh; steep slopes for Ll.	Slight for Le and Lg; moderate for Lh: slopes of more than 5 percent; severe for Ll: slopes of more than 10 percent.	Severe: very porous substratum.
Moderate to moderately slow permeability; unstable ditchbanks; high dispersion.	High seasonal water table; very high salinity.	Very high salinity; very strong alkalinity; moderate to moderately slow permeability; high dispersion.	----------	----------	Low bearing capacity; water table within 72 inches of the surface; moderate to moderately slow permeability; very high salinity.	Severe: high dispersion; fluctuating water table.	Severe: high water table.
----------	----------	----------	Bedrock at a depth of 8 to 20 inches.	Shallow to bedrock; low available water capacity.	Moderate bearing capacity; medium compressibility; shallow to bedrock.	Severe: hard shale and sandstone at a depth of 8 to 20 inches.	Severe: shallow to bedrock.
----------	----------	----------	----------	----------	Low bearing capacity; high shrink-swell potential; slow permeability; high compressibility; moderately steep slopes.	Severe: shale at a depth of 10 to 20 inches; moderately steep slopes; slow permeability.	Severe: moderately steep slopes.

TABLE 5—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Lohmiller: Lo, Lr, Ls, Lu (For interpretations of the Hysham soil in Lu, refer to the Hysham series.)	Good to fair: clayey material.	Poor: well-graded sand and gravel below a depth of 48 inches on stream terraces.	Poor: well-graded sand and gravel at a depth of 48 inches on stream terraces.	Fair to poor: low shear strength; medium plasticity; moderate volume change.	Medium compressibility and expansion; moderate to high frost-action potential; high capillarity.	Features generally favorable.	Medium compressibility; moderate to low dry density; moderate to high shrink-swell potential.
Lt (For interpretations of the Elso soil in this unit, refer to the Elso series.)	Good to fair: clayey material.	Poor: well-graded sand and gravel below a depth of 48 inches on stream terraces.	Poor: well-graded sand and gravel at a depth of 48 inches on stream terraces.	Fair to poor: low shear strength; medium plasticity; moderate volume change.	Medium compressibility and expansion; moderate to high frost-action potential; high capillarity.	Features generally favorable.	Medium compressibility; moderate to low dry density; moderate to high shrink-swell potential.
Lv	Good to fair: clayey material.	Fair: well-graded sand and gravel at a depth of 20 to 40 inches.	Good: well-graded sand and gravel at a depth of 20 to 40 inches.	Fair to poor: low shear strength; medium plasticity; moderate volume change.	Medium compressibility and expansion; moderate to high frost-action potential; high capillarity.	Substratum too porous.	Medium compressibility; moderate to low dry density; moderate to high shrink-swell potential.
Maginnis: Ma, Mc, Mg (Rock outcrop in Mg not interpreted.)	Unsuitable	Unsuitable	Unsuitable	Fair to poor: moderate shear strength; moderate bearing capacity; depth to bedrock is 4 to 15 inches.	Shale bedrock at a depth of 4 to 15 inches; good stability in road cuts.	Shallow soil; seepage into shattered bedrock; strongly sloping to steep.	Fair stability
McKenzie: Mk	Unsuitable	Unsuitable	Unsuitable	Unsuitable	High compressibility and expansion; high elasticity; high volume change; moderate frost-action potential; occasional flooding or ponding	Features generally favorable.	Low dry density; high shrink-swell potential; high compressibility.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
Moderately slow permeability; unstable ditchbanks.	Features generally favorable.	Moderately slow permeability and intake rate.	Moderate risk of erosion.	Moderate risk of erosion.	Low bearing capacity; moderate shrink-swell potential; moderately slow permeability; seasonal high water table if irrigated.	Severe: moderately slow permeability; seasonal high water table if irrigated.	Severe: slopes of more than 7 percent.
- - - - - -	- - - - - -	- - - - - -	Moderately steep, uneven slopes; low stability in embankments.	Severe risk of erosion; moderately slow permeability and intake rate.	Low bearing capacity; moderate shrink-swell potential; moderately slow permeability; seasonal high water table if irrigated; moderately steep slopes.	Severe: moderately steep slopes; moderately slow permeability.	Moderate to severe: slopes.
Features generally favorable.	Deep cuts may expose sand and gravel.	Moderately slow permeability and intake rate.	- - - - - -	- - - - - -	Low bearing capacity; moderate shrink-swell potential; moderately slow permeability; seasonal high water table if irrigated.	Slight to moderate: moderately slow permeability; rapid permeability below a depth of 20 to 40 inches; seasonal high water table.	Slight: contains coarse fragments.
- - - - - -	- - - - - -	- - - - - -	Shallow to shale; rough, broken, and steep.	Shallow to shale; strongly sloping to steep slopes; low available water capacity.	Shallow to shale; high bearing capacity; medium compressibility.	Severe: shale at a depth of 4 to 15 inches; strongly sloping to steep slopes.	Severe: strong slopes; contains coarse fragments.
- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	Occasional ponding; low bearing capacity; high shrink-swell potential.	Severe: very slow permeability; surface ponding.	Slight: flooding or ponding.

TABLE 5—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
McRae: Mm, Mn, Mo, Mr, Ms, Mt, Mu, Mv. (For interpretations of the Bainville soil in Ms and Hysham soil in Mt, Mu, and Mv, refer to their respective series.)	Good	Unsuitable	Unsuitable	Fair to poor: medium dry density; high frost-action potential; fair compaction.	Medium compressibility and expansion; fair to low bearing capacity; high erodibility in deep cuts.	Moderate permeability for Mm, Mn, Mo, Mt, Mu, and Mv, and slopes of 1 to 7 percent; slopes of 7 to 15 percent for Mr and Ms.	Poor compaction; low stability; moderate permeability in compacted embankments; moderate to low dry density; subject to piping.
Midway: Mw, My (For interpretations of the Razor soil in Mw and Shale outcrop in My, refer to the Razor series and Shale outcrop.)	Poor: clayey.	Unsuitable	Unsuitable	Poor: medium plasticity; high dry density; low shear strength; high volume change; not a source of good construction material.	Medium compressibility; high capillarity; moderate frost-action potential; unstable slopes on deep cuts; steep, rough, and broken.	Shallow to pervious shale.	Medium compressibility; moderate dry density; high volume change.
Oburn: Oh, Os (For interpretations of the Shaak soil in these units, refer to the Shaak series.)	Good to a depth of 6 to 8 inches; unsuitable below; too clayey.	Poor: depth to well-graded sand and gravel varies but is below 40 inches in most places.	Good to poor: depth to sand and gravel varies but is below 40 inches in most places.	Poor to unsuitable: low dry density; high volume change; high plasticity.	High compressibility and expansion; high elasticity; low bearing capacity; high shrink-swell potential; moderate frost-action potential.	Porous substratum at a depth of 30 inches.	Low dry density; low shear strength; high volume change; poor workability.
Pierre: Pc, Pl (For interpretations of the Lismas soil in Pl, refer to the Lismas series.)	Unsuitable: too clayey.	Unsuitable	Unsuitable	Poor to unsuitable: low dry density; high volume change; slow permeability; high plasticity.	High compressibility and expansion; moderate frost-action potential; high shrink-swell potential; slow permeability; low bearing capacity; shale at a depth of 20 to 40 inches.	Features generally favorable.	Low dry density; low shear strength; high volume change; poor workability; low stability.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
Moderate permeability; unstable ditchbanks.	Features generally favorable.	Features generally favorable for Mm and Mt; moderate risk of erosion for Mm, Mo, Mu, and Mv.	Features generally favorable for Mm and Mt; moderate risk of erosion for Mn, Mo, Mu, and Mv; severe risk of erosion for Mr and Ms.	Features generally favorable for Mm and Mt; moderate risk of erosion for Mn, Mo, Mu, and Mv; severe risk of erosion for Mr and Ms.	Low bearing capacity; medium compressibility; high frost-action potential; severe risk of erosion where slopes are moderately steep.	Slight to moderate on slopes of 1 to 7 percent; moderate permeability; severe on slopes of 7 to 15 percent.	Severe: moderately steep slopes.
------------	------------	------------	Shallow to shale; high erodibility; slow permeability and intake rate.	High erodibility where cuts expose shale; difficult to establish vegetation.	Medium bearing capacity; medium to high compressibility; moderate frost-action potential; shale at a depth of 10 to 20 inches; moderately steep slopes.	Severe: shale at a depth of 10 to 20 inches: slow permeability; moderately steep slopes.	Moderate on gentle slopes; severe on moderately steep slopes.
------------	------------	------------	Low shear strength; high volume change; poor workability; low stability in embankments.	Shaping exposes clay subsoil; slow permeability and intake rate.	Low bearing capacity; high shrink-swell potential; slow permeability.	Severe: slow permeability.	None.
------------	------------	------------	Shallow to shale; uneven slopes; slow permeability.	Shallow to shale; moderate risk of erosion on steeper slopes.	Low bearing capacity; high shrink-swell potential; moderate frost-action potential; slow permeability; shale at a depth of 20 to 40 inches.	Severe: slow permeability; shale at a depth of 20 to 40 inches.	Moderate to severe: slopes.

TABLE 5 *Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Razor: Ra, Rc (For interpretations of the Cushman soil in Rc, refer to the Cushman series.)	Fair: clayey.	Unsuitable	Unsuitable	Poor to unsuitable: medium plasticity; moderate dry density; low shear strength; moderate frost-action potential.	Medium compressibility; high capillarity; moderately slow permeability; moderate frost-action potential; unstable slopes in deep cuts; shale at a depth of 20 to 40 inches.	Features generally favorable.	Medium compressibility; moderate dry density; moderately slow permeability in compacted embankments; moderate volume change.
Riverwash: Re	Unsuitable	Good to poor	Good to poor	Good for subgrade.	High risk of of flooding.		
Rock land: Rk	Unsuitable	Unsuitable	Unsuitable	Variable: can be used for subgrade.	Very steep, rough, and broken; rock outcrops in many places.		
Ryegate: Rn, Rr, Rt (For interpretations of the Travessilla soil in Rr and Rt, refer to the Travessilla series.)	Fair: high sand content; subject to soil blowing.	Unsuitable	Unsuitable	Good: fair to good compaction; slow permeability in compacted fill; good workability.	Moderate frost-action potential; hard sandstone at a depth of 20 to 40 inches.	Moderately slow permeability; bedrock at a depth of 20 to 40 inches.	Subject to piping.
Sage: Sa	Unsuitable	Poor: well-graded sand and gravel at a depth of 72 inches on river terraces only.	Poor: water table in gravel on river terraces.	Poor to unsuitable: very high salinity; high dispersion; poor compaction; low stability; very poor workability.	Depth to water table is 12 to 36 inches; low stability; high compressibility; low bearing capacity.	Features generally favorable.	Low shear strength; poor compaction; high dispersion; very poor workability; subject to piping.
Shaak: Sh, Sk	Fair to good to a depth of 7 inches; poor below; too clayey.	Fair to poor: overburden is 60 inches thick; some plastic fines.	Fair to poor: overburden is 60 inches thick.	Poor: low dry density; medium plasticity; low shear strength; low bearing capacity.	High compressibility; high capillarity; slow permeability; moderate frost-action potential; high plasticity.	Features generally favorable.	Low dry density; medium compressibility; moderate to low stability; high shrink-swell potential.

engineering properties —Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
------------	------------	------------	Uneven slopes; shale at a depth of 20 to 40 inches.	Shallow soils; shale at a depth of 20 to 40 inches.	Low bearing capacity; moderate shrink-swell potential; moderately slow permeability; shale at a depth of 20 to 40 inches.	Severe: moderately slow permeability; shale at a depth of 20 to 40 inches.	Moderate: slopes.
------------	------------	------------	------------	------------	------------	Severe: high water table; subject to annual flooding.	Severe: flooding hazard.
------------	------------	------------	------------	------------	Very steep, rough, and broken; shallow to bedrock.	Severe: very steep slopes; shallow to bedrock.	Severe: steep slopes.
------------	------------	------------	Sandstone at a depth of 20 to 40 inches; moderate to low stability in embankments.	Moderate risk of erosion.	Bedrock at a depth of 20 to 40 inches.	Severe: sandstone bedrock at a depth of 20 to 40 inches; moderately slow permeability.	Severe: shallow to bedrock.
Very slow permeability; high dispersion; unstable ditchbanks; high erodibility.	Very high salinity; very poor workability; surface crusting.	Very slow permeability.	------------	------------	High water table; very high salinity; very slow permeability.	Severe: high water table; very slow permeability.	Severe: high water table.
------------	------------	------------	Poor workability; moderate stability in embankments; uneven slopes; slow permeability and intake rate.	Slow permeability and intake rate.	High shrink-swell potential; slow permeability; low bearing capacity.	Severe: slow permeability.	Moderate: slopes of more than 2 percent.

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TABLE 5—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Shale outcrop: Sl, Sm (For interpretations of the Midway soil in Sm, refer to the Midway series.)	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Strongly sloping to steep, uneven slopes; not a source of good construction material.	Features generally favorable.	------------
Shonkin: Sn	Fair	Unsuitable	Poor: thick overburden.	Poor: high shrink-swell potential; low shear strength.	High compressibility; slow permeability.	Features generally favorable.	Low stability; high shrink-swell potential.
Shorey: So, Sr	Fair: gravelly; high lime content.	Unsuitable	Poor: too many fines; requires washing and screening.	Fair to good: moderate dry density; moderate frost-action potential; moderate to high shear strength; good workability.	Medium to low compressibility and expansion; medium bearing capacity; moderate permeability.	Moderate permeability; sand and gravel lenses in substratum below a depth of 36 inches.	Moderate dry density; moderate to high shear strength; good workability.
Thurlow: Ta, Tc	Good to fair to a depth of 8 inches; poor below; too clayey.	Unsuitable	Unsuitable	Fair to poor: medium dry density; fair compaction.	Medium to high compressibility and expansion; moderate frost-action potential; high capillarity.	Slopes of more than 4 percent.	Fair stability; medium dry density; fair compaction; low shear strength; moderate volume change.
Toluca: Te, Th, Tm, Tn, To. (For interpretations of the Wanetta soil in Tn and To, refer to the Wanetta series.)	Fair to a depth of 8 inches.	Fair to good: depth to well-graded sand and gravel is 36 to 60 inches.	Good: depth to well-graded sand and gravel is 36 to 60 inches.	Fair to good: good workability.	Features generally favorable.	Moderate permeability increasing below a depth of 48 inches.	Fair stability to a depth of 24 inches; fair compaction; moderate shear strength; moderate volume change.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
----------	----------	----------	----------	----------	Very shallow to shale; steep, rough, and broken.	Severe: very shallow to shale; very steep slopes in places.	Severe: steep slopes.
Slow permeability.	Poor workability.	Slow runoff; slow permeability.	----------	Slow permeability.	High shrink-swell potential; high compressibility.	Severe: high overflow hazard; slow permeability.	Moderate: flooding hazard.
----------	Uneven slopes; deep cuts may expose gravel and sand lenses.	Uneven slopes; moderate erodibility.	Uneven slopes; moderate risk of erosion; moderate stability in embankments.	Moderate risk of erosion.	Medium bearing capacity; moderate permeability; low shrink-swell potential.	Slight where slopes are 1 to 4 percent; moderate where slopes are 4 to 7 percent.	Moderate: slopes.
Moderately slow permeability; moderately stable ditchbanks.	Features generally favorable.	Features generally favorable.	Moderate shear strength; low to moderate erodibility; fair workability.	Slopes; moderate risk of erosion.	Low bearing capacity; moderately slow permeability; moderate frost-action potential; moderate shrink-swell potential.	Severe: moderately slow permeability.	Moderate: slopes of more than 2 percent.
Moderate permeability.	Uneven surface on steeper slopes; deep cuts expose calcareous substratum.	Features generally favorable for Tc and Tn; moderate risk of erosion for Th and To; severe risk of erosion for Tm.	Moderate stability; fair workability; moderate shear strength; high risk of erosion in the calcareous substratum.	Moderate risk of erosion on steeper slopes if cuts are more than 18 inches deep.	Medium bearing capacity; moderate shrink-swell potential; moderate permeability.	Slight to moderate: moderate permeability; strong slopes.	Moderate: slopes of more than 2 percent.

TABLE 5—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Travessilla: Tr, Ts, Tt	Unsuitable	Unsuitable	Unsuitable	Fair: medium shear strength; medium to low compressibility.	Hard sandstone at a depth of 10 to 20 inches; stones interfere with grading; limited source of fill material.	Slopes of 4 to 15 percent; seepage through bedrock fractures and at contact between fill and bedrock; depth to bedrock is 10 to 20 inches.	Soil too porous and stony for good compaction; limited source of fill material.
Treasure: Tu, Tw	Good	Unsuitable	Unsuitable	Good: high dry density; high shear strength; moderate to low volume change; good stability.	Low compressibility; moderate shrink-swell potential; moderate frost-action potential.	Moderately rapid permeability in substratum; gentle slopes.	High dry density; low compressibility; moderate permeability in compacted embankments.
Vananda: Va, Vd, Ve. (For interpretations of the Bone soil in Ve, refer to the Bone series.)	Unsuitable	Unsuitable	Unsuitable	Poor to unsuitable: low dry density; high volume change; high plasticity; very slow permeability; unstable slopes.	High compressibility and expansion; high elasticity; high shrink-swell potential; moderate frost-action potential; very slow permeability.	Features generally favorable.	Low dry density; poor compaction; low stability.
Wanetta: Wa, Wc, We, Wf, Wg, Wh, Wk, Wl. (For interpretations of the Larim soil in Wh, Wk, and Wl, refer to the Larim series.)	Fair to good: some pebbles and cobblestones on surface.	Fair: well-graded sand and gravel at a depth of 20 to 40 inches; screening required to remove gravel.	Good: well-graded sand and gravel at a depth of 20 to 40 inches.	Good: well-graded material; good workability.	Features generally favorable.	Very porous substratum at a depth of 20 to 40 inches.	Fair stability; moderate dry density; fair compaction; some pebbles and cobblestones.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
----------	----------	----------	Depth to bedrock is 10 to 20 inches.	Depth to bedrock is 10 to 20 inches; low available water capacity.	Depth to bedrock is 10 to 20 inches.	Severe: hard bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of less than 40 inches.
----------	Features generally favorable.	Moderate risk of erosion.	Unstable embankments; risk of erosion moderate for Tu and moderate to high for Tw.	Highly erodible substratum.	Low compressibility; moderate frost-action potential.	Slight to moderate : moderate permeability; strong slopes.	Severe: strong slopes.
Very slow permeability; high dispersion.	Deep cuts expose saline substratum; poor workability.	Very slow permeability and intake rate; poor workability.	Low shear strength; high dispersion; poor workability; very slow permeability and intake rate.	Strongly alkaline soils; vegetation difficult to establish.	Low bearing capacity; high shrink-swell potential; very slow permeability.	Severe: very slow permeability; fine texture.	Moderate: slopes.
Features generally favorable.	Uneven surface; deep cuts expose gravelly substratum.	Rough, broken topography; low to moderate available water capacity.	Deep cuts expose gravelly substratum.	Deep cuts expose gravelly substratum.	Water table within 60 inches of the surface in irrigated areas.	Slight to moderate: slopes.	Moderate: slopes of more than 2 percent.

TABLE 5—*Interpretations of*

Soil series and map symbols	Suitability as a source of—				Soil features affecting—		
	Topsoil	Sand	Gravel	Road fill	Highway location	Farm ponds	
						Reservoir area	Embankment
Work: Wm, Wn	Good to a depth of 6 to 8 inches; fair to poor below.	Unsuitable	Unsuitable	Fair to poor: moderate shear strength; medium compressibility; medium dry density; medium bearing capacity.	Medium compressibility and expansion; moderate frost-action potential; moderate capillarity; moderately slow permeability.	Moderately slow permeability; soil in narrow valleys may contain sand and gravel lenses below a depth of 48 inches.	Fair stability; medium; dry density; fair compaction; moderate shear strength.
Worland: Wo, Wr (For interpretations for the Travessilla soil in Wr, refer to the Travessilla series.)	Fair: sandy material.	Unsuitable	Unsuitable	Good: high dry density; high shear strength; low plasticity; low volume change; good stability.	High dry density; high shear strength; good compaction; good source of construction material.	Weakly consolidated sandstone at a depth of 20 to 40 inches; moderately rapid permeability.	Fair stability; moderate permeability in compacted embankments; moderately rapid permeability.
Wormser: Ws, Wt, Wv, Ww (For interpretations of the Lavina soils in Wv and the Worland soil in Ww, refer to their respective series.)	Fair to good to a depth of 6 to 8 inches; poor below.	Unsuitable	Unsuitable	Poor to unsuitable: moderate to low shear strength; moderate compressibility; fair compaction; medium bearing capacity; medium dry density.	Medium compressibility and expansion; moderate shrink-swell potential; moderate frost-action potential; shale and sandstone at a depth of 20 to 40 inches.	Moderately slow permeability; porous shale at a depth of 20 to 40 inches; moderate slopes.	Fair stability; moderate permeability in compacted embankments; moderate shear strength; moderate dry density.
Yegen: Ya, Yc, Ye, Yt (For interpretations of the Toluca soil in Yt, refer to the Toluca series.)	Fair to good.	Unsuitable	Unsuitable	Good: high dry density; high shear strength; low volume change; fair to good compaction.	Low compressibility; moderate shrink-swell potential; moderate frost-action potential.	Moderately rapid permeability in the lower substratum.	High dry density; slow permeability in compacted embankments.

engineering properties—Continued

Soil features affecting—Continued						Limitations for—	
Agricultural drainage	Land leveling	Irrigation	Terraces and diversions	Waterways	Building sites	Sewage disposal fields	Sewage lagoons
------------	------------	Moderate risk of erosion.	Moderate shear strength; fair workability; moderate risk of erosion.	Moderate risk of erosion.	Medium bearing capacity; moderately slow perability; moderate frost-action potential; moderate shrink-swell potential.	Severe: moderately slow permeability.	Moderate: slopes.
------------	------------	------------	High risk of soil blowing; sandstone at a depth of 20 to 40 inches.	Sandy soils; high risk of erosion; moderate available water capacity; difficult to establish vegetation; sandstone at a depth of 20 to 40 inches.	Weakly consolidated sandstone at a depth of 20 to 40 inches; strong slopes in some areas.	Severe: sandstone at a depth of 20 to 40 inches.	Moderate to severe: slopes.
------------	------------	------------	Uneven slopes; fair workability; deep cuts expose shale substratum.	Moderate risk of erosion; shale and sandstone at a depth of 20 to 40 inches.	Medium bearing capacity; moderately slow permeability; moderate frost-action potential; moderate shrink-swell potential; shale and sandstone at a depth of 20 to 40 inches.	Severe: shale and sandstone at a depth of 20 to 40 inches; moderately slow permebility.	Severe: bedrock at a depth of less than 40 inches.
Unstable ditchbanks.	Slopes moderately steep in some places.	Moderately rapid permeability in lower substratum; highly erodible on stronger slopes; moderate risk of erosion in less sloping areas.	Moderate risk of erosion.	Moderate risk of erosion.	Medium to high compressibility; medium to high bearing capacity; moderately steep slopes.	Severe: moderately slow permeability.	Severe: slopes.

(3) highly organic soils. The highly organic soils do not occur in Yellowstone County.

The fifteen basic groups in the system range from GW to GP, which are clean sands with few or no fines, through ML and CL to CH. Soils in the ML and CL groups are inorganic silts and clays. Soils in the CH group are inorganic clays (fat clays) in which 30 percent of the material passes the No. 200 sieve. Soils that are borderline between two classifications have a joint classification, for example, ML–CL.

In both the Unified and AASHO systems, the fine fractions of the soil are separated into groups by use of sieves having openings of different size. The No. 4 sieve takes out particles larger than approximately ¼ inch. The No. 10 sieve takes out particles ranging in size from 2 millimeters to ¼ inch, and the No. 200 sieve takes out particles larger than 0.074 millimeter. In both the AASHO and United systems, the weight of the fines passing through the No. 200 sieve in proportion to the total weight of the soil is the most important single factor in determining in which group a soil is placed.

The textural classification used by the United States Department of Agriculture (USDA) is based on relative percentage of sand, silt, and clay, by weight. Bearing strength, plasticity, and liquid limits are not considered.

Engineering test data

Table 3 lists results from tests made on soil samples from soils in Yellowstone County. The tests were made according to standard procedures so that the soils could be evaluated for engineering purposes.

The results of a mechanical analysis, obtained by the combined sieve and hydrometer method, can be used to determine relative proportions of different size particles that make up the soil sample. The clay content obtained by the hydrometer method, which generally is used by engineers, should not be used to determine textural soil classes.

In a moisture density or compaction test, a sample of soil material is compacted several times with the same compactive effort, each time at a higher moisture content. The dry density (unit weight) of the soil material increases until "optimum moisture content" is reached. After that, the dry density decreases with an increase of moisture content. The highest dry density obtained is termed "maximum dry density." Moisture density data are important in earthwork because, as a rule, optimum stability is obtained if the soil is compacted to about maximum stability when it is at approximately optimum moisture content.

The values for liquid limit and plasticity index indicate the effect of water on the consistence of soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which a material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes to a liquid state. The numerical difference between the liquid limit and plastic limit is the plasticity index. It indicates the range of moisture content within which the soil material is in a plastic condition.

Estimated engineering properties of the soils

Table 4 lists the soil series and some land types in the county and gives estimates of soil properties that are significant in engineering. Alluvial lands, Riverwash, Rock land, Rock outcrop, and Shale outcrop are not listed, because their properties are too variable to evaluate. Alluvial lands are more than 5 feet deep to bedrock.

The estimates in table 4 are based on test data for similar soils in this county or other counties and on past experience in engineering construction. The estimates are given for specified layers of a profile typical for the series; consequently, considerable variation from the estimates should be expected.

The column "Depth to seasonal high water table" was omitted because the high water table is at a depth of 5 feet or more in all of the soils in the county except the following: Alluvial land, mixed, where depth to the high water table is 3 to 5 feet; Alluvial land, seeped, less than 3 feet; Alluvial land, wet, less than 1 foot; Laurel soils, 3 to 5 feet; Lohmiller silty clay, 0 to 1 percent slopes, 4 to 5 feet; Lohmiller silty clay, gravelly variant, 0 to 1 percent slopes, 3 to 5 feet; and Sage clay, 1 to 3 feet.

Some of the columns in table 4 need no explanation; others are explained in the following paragraphs.

Permeability indicates the rate at which water moves downward through undisturbed soil material. The rate depends largely on texture, porosity, and structure of the soil. A rate of less than 0.2 inches per hour is slow; 0.2 to 0.63, moderately slow; 0.63 to 2 inches, moderate; 2 to 6.3 inches, rapid; and more than 6.3 inches, very rapid.

Available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. Available water capacity is affected by the texture, structure, and organic-matter content of the soil.

Reaction, or the degree of acidity or alkalinity, is given in pH values and in words in the Glossary.

The salinity of the soils depends on the content of soluble salts, such as sodium chloride, sodium sulfate, and gypsum. It is estimated according to the electrical conductivity of the soil saturation extract, expressed in millimhos per centimeter at 25° C. The relative terms used to rate salinity are defined as follows: *none*, less than 2 millimhos per centimeter; *low*, 2 to 4; *moderate*, 4 to 8; *high*, 8 to 15; and *very high*, more than 15.

In the estimates for corrosivity of untreated steel pipe, the factors considered were total acidity, soil drainage, and soil texture.

The shrink-swell potential indicates the volume change to be expected with a change in moisture content. The volume change is determined primarily by the amount and kind of clay in the soil. Clay and silty clay soils that are classified A–7 generally have a high shrink-swell potential. Clean sand and gravel and other soils that contain small amounts of nonplastic and slightly plastic fines have low shrink-swell potential.

The frost-action potential affects the suitability of soils for road construction and building sites. A soil that has high frost action, or frost heave, is not suitable for these uses.

Interpretations of engineering properties of the soils

In table 5 the soils of Yellowstone County are rated according to their suitability for engineering uses. Also listed in this table are soil features that affect specified engineering practices and structures. The ratings given for bearing capacity are estimates and should not be assigned specific values.

The suitability of the soils as a source of topsoil, sand, gravel, or road fill is rated *good*, *fair*, *poor*, and *unsuitable*. Topsoil is fertile material, generally rich in organic matter, that is used to topdress roadbanks, parks, gardens, and lawns. Sand is material suitable for use in concrete or as other construction material. Gravel consists of particles larger than sand, but it also is material suitable for use in construction. Road fill is material used for embankments that support the subbase and base courses below the surface course of a road. Suitability of the soil as a source of road fill depends largely on the texture of the soil and the natural content of water. Soils that are highly plastic and that have a high natural content of water generally are rated poor.

Among the soil features affecting the locations of highways are erodibility, shrink-swell potential and plasticity, flooding, ponding, and depth to bedrock.

Some of the soil features affecting use of soils for reservoirs and embankments for farm ponds are susceptibility to seepage, the sealing potential of the soil material, depth to a high water table, depth to bedrock, stability, permeability, shrink-swell potential, and compactibility. Susceptibility to soil blowing also affects embankments.

Agricultural drainage is affected by natural drainage, permeability, texture and structure, flooding, and stability of ditchbanks.

Land leveling, which is required in some places before irrigation is successful, depends largely on slope and depth to bedrock. Soils that are suitable for irrigation are well drained, but they contain enough fine material to have good available water capacity.

Soil features that affect terraces and diversions are slope, depth to bedrock, erodibility, texture, and permeability.

Waterways require soils that support fast-growing cover plants and that are not subject to erosion. Special care is needed to establish vegetation on soils that have low available water capacity and low fertility.

Building sites require soils that have a low shrink-swell potential, that are stable, that are not flooded or ponded, and that do not have a seasonal high water table.

Suitability of the soil material for sewage disposal fields is affected by permeability, slope, a seasonal high water table, and susceptibility to flooding.

A sewage lagoon is a shallow lake used to hold sewage for the time required for bacterial decomposition. The soil used for sewage lagoons is required to act as the floor of the impounded area and as a dam. The requirements for the dam are the same as those given for a farm pond embankment in table 5. Soils on the floor of a lagoon should be impervious to seepage, have little slope, and have little or no organic matter. An impervious floor is especially important where shallow wells are nearby.

Descriptions of the Soils

This section describes the soil series and mapping units in Yellowstone County. The approximate acreage and proportionate extent of each mapping unit are given in table 6.

The procedure in this section is first to describe the soil series and then the mapping units in the series. Thus, to get full information on any one mapping unit, it is necessary to read the description of the unit and also the description of the soil series to which it belongs. The description of each mapping unit contains suggestions on how the soil can be used and managed. The description of a soil series mentions features that apply to all the soils in the series. Differences among the soils of one series are pointed out in the descriptions of the individual soils or are indicated in the soil name. Unless otherwise stated, the descriptions of all mapping units in this section are for moist soils. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. For example, Riverwash is a miscellaneous land type and does not belong to a soil series; nevertheless, it is listed in alphabetic order along with the series.

An essential part of each soil series is the description of the soil profile, that is, the sequence of layers beginning at the surface and continuing downward to the depth beyond which roots of most plants do not penetrate. Each soil series contains a short description of a soil profile that has characteristics or ranges of characteristics within the ranges set for the series. Also given for the soil series is a much more detailed description of a profile representative of the series. Scientists, engineers, and others can use this detailed description in making highly technical interpretations.

Absarokee Series

The Absarokee series consists of well-drained, gently sloping to sloping, moderately fine textured soils. These soils formed on smooth uplands in material weathered from underlying hard shale or sandstone. The native vegetation is grasses, forbs, and scattered shrubs. Elevation ranges from 3,600 to 4,800 feet. The annual precipitation is 14 to 16 inches, the mean annual temperature is 44° F., and the frost-free season is about 115 days. These soils are associated with Maginnis and Amherst soils.

In a typical profile, the surface layer is grayish-brown loam about 3 inches thick. In cultivated areas this layer is mixed with the dark grayish-brown clay loam upper part of the subsoil to form a dark grayish-brown clay loam plow layer about 6 inches thick. The plow layer is medium to high in organic-matter content. The subsoil, about 18 inches thick, is dark grayish-brown and light yellowish-brown clay and pale-brown very channery clay loam. The substratum is light yellowish-brown very channery clay loam. Hard platy sandstone is at a depth of about 33 inches.

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TABLE 6.—*Approximate acreage and proportionate extent of the soils*

Soil or land type	Area	Extent
	Acres	*Percent*
Absarokee clay loam, 1 to 4 percent slopes	10, 622	0. 6
Absarokee clay loam, 4 to 7 percent slopes	10, 439	. 6
Alluvial land, gravelly	1, 610	. 1
Alluvial land, mixed	5, 557	. 3
Alluvial land, seeped	1, 850	. 1
Alluvial land, wet	1, 342	. 1
Amherst clay loam, 7 to 15 percent slopes	2, 447	. 1
Amherst-Maginnis channery clay loam, 4 to 7 percent slopes	6, 700	. 4
Apron loamy fine sand, 4 to 7 percent slopes	3, 237	. 2
Apron fine sandy loam, 4 to 7 percent slopes	7, 106	. 4
Apron-Travessilla loamy fine sands, 7 to 15 percent slopes	4, 526	. 3
Arvada clay loam, 0 to 1 percent slopes	3, 536	. 2
Arvada clay loam, 1 to 4 percent slopes	2, 833	. 2
Arvada clay loam, 4 to 7 percent slopes	508	(1)
Arvada-Bone silty clay loams, 0 to 1 percent slopes	7, 883	. 5
Arvada-Bone clays, 0 to 1 percent slopes	7, 834	. 5
Bainville loam, 2 to 7 percent slopes	42, 965	2. 6
Bainville loam, 7 to 15 percent slopes	52, 204	3. 1
Bainville-Elso complex, 15 to 35 percent slopes	28, 116	1. 7
Bainville-Elso-Shale outcrop complex, 7 to 25 percent slopes	63, 780	3. 8
Bainville-Rock outcrop complex, 15 to 45 percent slopes	100, 041	5. 9
Bainville-Worland complex, 4 to 7 percent slopes	27, 145	1. 6
Bew silty clay loam, 0 to 1 percent slopes	3, 243	. 2
Bew clay, 0 to 1 percent slopes	3, 059	. 2
Bew clay, 1 to 4 percent slopes	753	(1)
Bew-Allentine clays, 0 to 1 percent slopes	1, 100	. 1
Big Horn clay loam, 0 to 2 percent slopes	2, 898	. 2
Bone silty clay, 0 to 1 percent slopes	1, 186	. 1
Bone silty clay, 1 to 6 percent slopes	370	(1)
Bone clay, 0 to 1 percent slopes	3, 741	. 2
Clapper clay loam, 15 to 35 percent slopes	3, 140	. 2
Clapper gravelly loam, 7 to 15 percent slopes	1, 763	. 1
Cushman-Bainville loams, 1 to 4 percent slopes	46, 336	2. 8
Cushman-Bainville loams, 4 to 7 percent slopes	20, 887	1. 2
Danvers silty clay loam, 2 to 4 percent slopes	13, 490	. 8
Danvers silty clay loam, 8 to 15 percent slopes	5, 539	. 3
Danvers-Judith complex, 7 to 15 percent slopes	587	(1)
Danvers-Shaak clay loams, 7 to 15 percent slopes	2, 045	. 1
Elso clay loam, 4 to 7 percent slopes	34, 639	2. 1
Elso clay loam, 7 to 15 percent slopes	33, 023	2. 0
Elso clay loam, 15 to 60 percent slopes	4, 425	. 3
Elso-Lohmiller complex, 15 to 35 percent slopes	19, 392	1. 2
Farland-Lambert silt loams, 0 to 4 percent slopes	2, 739	. 2
Fattig sandy clay loam, 4 to 7 percent slopes	744	(1)
Fort Collins-Arvada clay loams, 0 to 1 percent slopes	1, 800	. 1
Fort Collins-Arvada clay loams, 1 to 4 percent slopes	199	(1)
Fort Collins and Thurlow clay loams, 0 to 1 percent slopes	3, 227	. 2
Fort Collins and Thurlow clay loams, 1 to 4 percent slopes	7, 238	. 4
Gilt Edge-Allentine complex, 2 to 7 percent slopes	2, 732	. 2
Glenberg fine sandy loam, 1 to 4 percent slopes	505	(1)
Glenberg loam, 0 to 1 percent slopes	1, 480	0. 1
Glenberg loam, gravelly substratum, 0 to 1 percent slopes	443	(1)
Grail clay loam, 2 to 4 percent slopes	720	(1)
Grail silty clay, 0 to 1 percent slopes	237	(1)
Grail soils, 2 to 15 percent slopes	3, 920	. 2
Haverson loam, 0 to 1 percent slopes	12, 112	. 7
Haverson loam, clay substratum, 0 to 1 percent slopes	315	(1)
Haverson clay loam, 0 to 1 percent slopes	1, 430	. 1
Haverson silty clay loam, 0 to 1 percent slopes	11, 285	. 7
Haverson silty clay loam, 1 to 3 percent slopes	1 , 892	. 8
Haverson-Hysham loams, 0 to 1 percent slopes	1, 642	. 1
Haverson and Lohmiller soils, 0 to 4 percent slopes	29, 475	1. 8
Haverson and Lohmiller soils, channeled, 0 to 35 percent slopes	17, 305	1. 0
Haverson loam, gravelly variant, 0 to 1 percent slopes	725	(1)
Heldt silty clay loam, 4 to 7 percent slopes	3, 971	. 2
Hesper silty clay loam, 0 to 1 percent slopes	1, 105	. 1
Hesper silty clay loam, 1 to 4 percent slopes	1, 506	. 1
Hilly gravelly land	78, 031	4. 6
Hopley loam, 4 to 7 percent slopes	2, 194	. 1
Hovert clay, 0 to 1 percent slopes	715	(1)
Hydro-Allentine complex, 2 to 7 percent slopes	4, 922	. 3
Hydro-Arvada clay loams, 0 to 2 percent slopes	5, 215	. 3
Hysham-Laurel loams, 0 to 2 percent slopes	1, 460	. 1
Hysham-Laurel silty clay loams, 0 to 2 percent slopes	1, 080	. 1
Hysham and Haverson soils, 0 to 4 percent slopes	5, 270	. 3
Keiser silty clay loam, 0 to 1 percent slopes	5, 750	. 3
Keiser silty clay loam, 1 to 4 percent slopes	6, 488	. 4
Keiser silty clay loam, 4 to 7 percent slopes	2, 449	. 1
Keiser and Hesper silty clay loams, 0 to 1 percent slopes	2, 557	. 2
Kyle silty clay, 0 to 1 percent slopes	3, 413	. 2
Kyle silty clay, 1 to 4 percent slopes	4, 306	. 3
Kyle silty clay, 4 to 7 percent slopes	5, 814	. 3
Lambert silt loam, 1 to 4 percent slopes	1, 312	. 1
Lambert silt loam, 4 to 7 percent slopes	1, 794	. 1
Lambert silt loam, 7 to 15 percent slopes	1, 217	. 1
Lambert soils, 7 to 35 percent slopes	6, 513	. 4
Larim loam, 0 to 4 percent slopes	716	(1)
Larim gravelly loam, 0 to 4 percent slopes	540	(1)
Larim gravelly loam, 4 to 7 percent slopes	241	(1)
Larim gravelly loam, 15 to 35 percent slopes	3, 000	. 2
Lavina loam, 2 to 4 percent slopes	4, 960	. 3
Lismas clay, 15 to 35 percent slopes	113, 528	6. 7
Lohmiller silty clay loam, 3 to 7 percent slopes	5, 442	. 3
Lohmiller silty clay, 0 to 1 percent slopes	12, 054	. 7
Lohmiller soils, seeped, 0 to 2 percent slopes	2, 450	. 1
Lohmiller-Elso complex, 4 to 15 percent slopes	27, 554	1. 6
Lohmiller-Hysham silty clay loams, 0 to 1 percent slopes	1, 000	. 1
Lohmiller silty clay, gravelly variant, 0 to 1 percent slopes	706	(1)
Maginnis channery clay loam, 7 to 15 percent slopes	2, 708	. 2
Maginnis channery clay loam, 15 to 35 percent slopes	27, 469	1. 6
Maginnis-Rock outcrop complex, 35 to 60 percent slopes	14, 580	. 9
McKenzie clay, 0 to 1 percent slopes	7, 611	. 5

See footnote at end of table.

TABLE 6.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil or land type	Area	Extent
	Acres	*Percent*
McRae loam, 0 to 1 percent slopes	24, 883	1. 5
McRae loam, 1 to 4 percent slopes	32, 852	2. 0
McRae loam, 4 to 7 percent slopes	53, 138	3. 2
McRae loam, 7 to 15 percent slopes	750	(1)
McRae-Bainville loams, 7 to 15 percent slopes	85, 697	5. 1
McRae-Hysham loams, 0 to 1 percent slopes	2, 541	. 2
McRae-Hysham loams, 1 to 3 percent slopes	2, 374	. 1
McRae-Hysham loams, 3 to 6 percent slopes	1, 579	. 1
Midway-Razor clay loams, 4 to 7 percent slopes	22, 372	1. 3
Midway-Shale outcrop complex	22, 380	1. 3
Oburn-Shaak complex, 0 to 1 percent slopes	2, 124	. 1
Oburn-Shaak complex, 1 to 4 percent slopes	3, 055	. 2
Pierre clay, 4 to 7 percent slopes	24, 340	1. 4
Pierre-Lismas clays, 7 to 15 percent slopes	19, 350	1. 2
Razor clay loam, 2 to 7 percent slopes	1, 755	. 1
Razor-Cushman complex, 2 to 4 percent slopes	999	. 1
Riverwash	1, 540	. 1
Rock land	6, 727	. 4
Ryegate fine sandy loam, 2 to 4 percent slopes	2, 251	. 1
Ryegate-Travessilla loams, 2 to 4 percent slopes	2, 003	. 1
Ryegate-Travessilla loams, 4 to 7 percent slopes	1, 604	. 1
Sage clay, 0 to 1 percent slopes	458	(1)
Shaak silty clay loam, 0 to 1 percent slopes	2, 493	. 2
Shaak silty clay loam, 1 to 4 percent slopes	9, 661	. 6
Shale outcrop	25, 890	1. 5
Shale outcrop-Midway complex, 15 to 35 percent slopes	2, 215	. 1
Shonkin loam, 0 to 1 percent slopes	620	(1)
Shorey gravelly loam, 1 to 4 percent slopes	820	. 1
Shorey gravelly loam, 4 to 7 percent slopes	1, 577	. 1
Thurlow clay loam, 0 to 1 percent slopes	1, 084	. 1
Thurlow clay loam, 4 to 7 percent slopes	2, 449	. 1
Toluca clay loam, 0 to 1 percent slopes	650	(1)
Toluca clay loam, 1 to 4 percent slopes	1, 652	. 1
Toluca clay loam, 4 to 7 percent slopes	1, 046	. 1
Toluca and Wanetta clay loams, 0 to 2 percent slopes	2, 558	. 2
Toluca and Wanetta clay loams, 2 to 4 percent slopes	391	(1)
Travessilla sandy loam, 4 to 15 percent slopes	4, 061	0. 2
Travessilla loam, 4 to 7 percent slopes	2, 275	. 1
Travessilla loam, 7 to 15 percent slopes	81, 570	4. 8
Treasure fine sandy loam, 1 to 4 percent slopes	789	. 1
Treasure fine sandy loam, 4 to 10 percent slopes	1, 928	. 1
Vananda silty clay, 0 to 1 percent slopes	17, 142	1. 0
Vananda silty clay, 1 to 7 percent slopes	4, 154	. 3
Vananda-Bone clays, 4 to 7 percent slopes	4, 307	. 3
Wanetta loam, 0 to 1 percent slopes	442	(1)
Wanetta loam, 1 to 4 percent slopes	462	(1)
Wanetta gravelly loam, 0 to 2 percent slopes	605	(1)
Wanetta clay loam, 0 to 1 percent slopes	1, 678	. 1
Wanetta clay loam, 1 to 4 percent slopes	935	. 1
Wanetta-Larim clay loams, 0 to 1 percent slopes	1, 143	. 1
Wanetta-Larim clay loams, 1 to 4 percent slopes	184	(1)
Wanetta-Larim clay loams, 4 to 7 percent slopes	371	(1)
Work clay loam, 1 to 4 percent slopes	977	. 1
Work clay loam, 4 to 7 percent slopes	3, 023	. 2
Worland fine sandy loam, 2 to 7 percent slopes	32, 539	1. 9
Worland-Travessilla fine sandy loams, 7 to 15 percent slopes	41, 582	2. 5
Wormser clay loam, 1 to 4 percent slopes	3, 882	. 2
Wormser clay loam, 4 to 7 percent slopes	6, 076	. 4
Wormser-Lavina clay loams, 2 to 4 percent slopes	6, 441	. 4
Wormser-Worland sandy loams, 4 to 7 percent slopes	3, 300	. 2
Yegen sandy loam, 0 to 1 percent slopes	769	(1)
Yegen sandy loam, 1 to 4 percent slopes	3, 760	. 2
Yegen sandy loam, 4 to 10 percent slopes	6, 927	. 4
Yegen and Toluca soils, 7 to 15 percent slopes	2, 857	. 2
Water area of the Yellowstone and Bighorn Rivers and Clarks Fork	5, 640	. 3
Total	1, 686, 400	100. 0

[1] Less than 0.1 percent.

Absarokee soils are used for dryfarmed small grains and hay.

Typical profile of Absarokee clay loam, 1 to 4 percent slopes, 1,600 feet east and 1,625 feet south of N¼ corner of section 29, T. 3 S., R. 25 E.:

A1—0 to 3 inches, grayish-brown (10YR 4/2) loam, very dark grayish brown when moist; weak, thin, platy structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; scattered light coatings of bleached sand grains on tops of plates; a few fragments of hard sandstone and shale; noncalcareous; pH 7.8; clear boundary.

B1—3 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) when moist; moderate, medium, prismatic structure; moderate clay films on vertical faces of peds; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.8; clear boundary.

B21t—6 to 9 inches, dark grayish-brown (10YR 4/2) light clay, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure that breaks to strong, medium, subangular blocky; hard when dry, firm when moist, very sticky and slightly plastic when wet; moderately thick clay films on all faces of peds; a few fragments of hard sandstone and shale; noncalcareous; pH 7.8; clear boundary.

B22t—9 to 14 inches, light yellowish-brown (10YR 6/4) light clay, yellowish brown (10YR 5/4) when moist; moderate, medium, prismatic structure that breaks to strong, fine, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; moderately thick clay films on all faces of peds; 15 percent shale fragments, by volume; noncalcareous; pH 7.8; gradual boundary.

IIB3—14 to 24 inches, pale-brown (10YR 6/3) very channery heavy clay loam, dark yellowish brown (10YR 4/3) when moist; strong, fine, blocky structure; hard when dry, firm when moist, sticky and plastic when wet;

moderately thick continuous clay films on vertical faces of peds; 50 percent sandstone and shale fragments that have thin lime undercoatings; pH 7.9; gradual boundary.

IIC—24 to 33 inches, light yellowish-brown (2.5Y 6/3) very channery light clay loam, light olive brown (2.5Y 5/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; shale and sandstone fragments that have lime undercoatings; pH 7.9; abrupt boundary.

IIR—33 inches +, fractured hard sandstone.

At the highest elevations, the A1 horizon is black (10YR 2/1) silt loam as much as 5 inches thick. The B2t horizon ranges from 7 to 24 inches in thickness. In many places the C horizon is absent in profiles that are less than 24 inches deep to bedrock. All horizons may contain as much as 20 percent angular fragments of hard sandstone. Depth to hard shale or sandstone ranges from 20 to 40 inches. The sandstone is noncalcareous, but the shale is calcareous. The presence of and depth to a lime horizon are determined by the presence of calcareous shale in the parent rock.

Absarokee clay loam, 1 to 4 percent slopes (Aa).—This soil occurs on smooth divides between deep valleys in the southern part of the county. Slopes are mainly 2 percent. At elevations above 4,500 feet, the surface layer is 7 to 8 inches thick, or thicker than that described as typical for the series.

The subsoil of this soil is moderately slow in permeability. Roots can penetrate to the bedrock. Runoff is slow, and excess moisture collects locally for short periods following hard rains. The hazard of soil blowing and water erosion is low. This soil is rich in organic matter and minerals. Available water capacity is 3 to 5 inches.

Except for the range on the Crow Indian Reservation, nearly all of this soil is used for dryfarmed crops. (Capability unit IIe-2, dryland; Silty range site, 15- to 19 inch precipitation zone)

Absarokee clay loam, 4 to 7 percent slopes (Ab).—This soil occurs on undulating uplands in the southern part of the county. It is on narrow ridges and the sides of the drainageways that are the heads of deep valleys. Slope is dominantly 4 percent. Included with this soil in mapping are small areas of Amherst clay loam and Maginnis channery clay loam.

Runoff is medium and, on slopes of more than 5 percent, the hazard of water erosion is moderate. Plant roots penetrate to the bedrock.

Nearly all this soil is used for dryfarmed crops. On the Crow Indian Reservation, it is used mostly for range. (Capability unit IIIe-4, dryland; Silty range site, 15- to 19-inch precipitation zone)

Allentine Series

The Allentine series consists of moderately deep and deep, well-drained, fine-textured soils. These soils formed in stream-deposited alluvium on terraces, or in residual material weathered from underlying shale and sandstone. The native vegetation is mainly western wheatgrass, sagebrush, and Sandberg bluegrass. Elevation ranges from 3,300 to 4,600 feet. The annual precipitation is 10 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days. Allentine soils are mapped only in complexes with Gilt Edge, Bew, and Hydro soils.

In a typical profile, the surface layer is light brownish-gray silty clay and clay about 10 inches thick. The subsoil is light olive-brown and light yellowish-brown clay about 13 inches thick. The upper part of the substratum is light yellowish-brown, strongly calcareous clay that contains a few soft masses of lime. Below this is light olive-gray clay that contains seams of gypsum. At a depth of about 50 inches is 5 inches of olive-gray clay that contains a few pebbles and is underlain by 5 inches of very gravelly sandy loam.

Allentine soils have slow permeability, moderate natural fertility, and low organic-matter content. The available water capacity is 8 to 10 inches of water to a depth of 5 feet.

These soils are used for irrigated crops, dryfarmed small grains, and range.

Typical profile of Allentine clay, 35 feet east of short stake in fence row, 95 feet north of W1/4 corner of section 10, T. 2 N., R. 27 E.:

Ap1—0 to 4 inches, light brownish-gray (2.5Y 6/2) silty clay, olive brown (2.5Y 4/3) when moist; strong, very fine, granular structure; very hard when dry, firm when moist, sticky and very plastic when wet; common, clear sand grains; pH 7.9; abrupt, smooth boundary.

AP2—4 to 10 inches, light brownish-gray (2.5Y 6/2) clay, olive brown (2.5Y 4/3) when moist; massive; very hard when dry, very firm when moist, sticky and extremely plastic when wet; common, clear sand grains; pH 7.8; abrupt, smooth boundary.

B2t—10 to 13 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure that breaks to strong, medium, blocky; extremely hard when dry, very firm when moist, very sticky and extremely plastic when wet; moderately thick, patchy clay films on ped faces; pH 8.0; clear, smooth boundary.

B3ca—13 to 23 inches, light yellowish-brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) when moist; weak, coarse, prismatic structure that breaks to moderate, medium, blocky; extremely hard when dry, very firm when moist, very sticky and extremely plastic when wet; strongly calcareous; common soft masses of lime; pH 7.9; gradual, wavy boundary.

C1—23 to 36 inches, light yellowish-brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) when moist; weak, coarse, blocky structure; extremely hard when dry, very firm when moist, very sticky and extremely plastic when wet; strongly calcareous; a few soft masses of lime and a few seams of gypsum; pH 8.0; clear, wavy boundary.

C2cs—36 to 44 inches, light olive-gray (5Y 6/2) clay, olive (5Y 4/3) when moist; massive; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; common seams of gypsum; strongly calcareous; pH 8.0; clear, wavy boundary.

C3—44 to 50 inches, light olive-gray (5Y 6/2) clay, olive (5Y 4/3) when moist; massive; extremely hard when dry, very firm when moist, very sticky and extremely plastic when wet; a few seams of gypsum; strongly calcareous; pH 8.0; gradual boundary.

C4—50 to 55 inches, olive-gray (5Y 5/2) clay, olive gray (5Y 4/2) when moist; massive; extremely hard when dry, very firm when moist, very sticky and extremely plastic when wet; a few pebbles; strongly calcareous; pH 8.0; gradual, wavy boundary.

C5—55 to 60 inches, very gravelly sandy loam (55 percent gravel).

Where undisturbed, Allentine soils have a surface layer of light brownish-gray silt loam or very fine sandy loam 1 to 3 inches thick. The structural peds of the B2t horizon are coated with moderately thick clay films. The depth to the lime layer is 10 to 15 inches, and the depth to the layer containing gypsum and other salts is 18 to 24 inches. On uplands the depth to bedrock ranges from 20 to 40 inches.

Alluvial Land

Four units of Alluvial land are mapped in the county. These are described in the following paragraphs.

Alluvial land, gravelly (Ag).—This land type consists of stratified alluvium in narrow valleys that receive runoff water from the gravel-capped uplands south of the Yellowstone River. Slopes are uneven and range from 0 to 4 percent. The alluvium is mostly loosely mixed sand and gravel on the channel floor and barren gravel bars. On the higher flood plain and small fans, the alluvium has a gravelly loam surface layer 5 to 10 inches thick. Here the surface is covered with grasses and shrubs. Cottonwood trees grow along the stream channel.

The areas are frequently flooded when rain is heavy or snow melts rapidly. Drainage is excessive, and the available water capacity is 2 to 3 inches. The fertility is low.

This land type is suited only to range. (Capability unit VIw-2, dryland; Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Alluvial land, mixed (Al).—This land type consists of thin, gravelly loam over loose gravelly sand alluvium. It occurs on flood plains and low terraces of river valleys. Slopes are mainly less than 1 percent. Some short slopes of 5 percent occur between terrace levels or along the sides of shallow channels and oxbows. Old channel scars and oxbows that are partly filled with alluvium make the surface uneven. The native vegetation is grasses, cottonwoods, willows, buckbrush, wild roses, and snowberry. Included in mapping are Haverson and Glenberg soils on the larger river islands.

The alluvium along the present river channel has a water table within 3 feet of the surface. Most areas along the channel are flooded by runoff water in spring and early in summer. Drainage is excessive, and the available water capacity is 2 to 3 inches. Fertility is low.

This land type is suited only to range. (Capability unit VIw-2, dryland; Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Alluvial land, seeped (Am).—This land type occupies partly filled stream channels and oxbows, terrace edges, and fans crossed by irrigation canals. Nearly all of it is in the irrigated parts of the river valleys. The alluvium is more than 5 feet deep and ranges from sandy loam to clay in texture. Slopes range from less than 1 percent on terraces and in stream channels to 8 percent on fans. The native vegetation is sedges, reedgrass, cattails, and willows.

The available water capacity is 6 to 10 inches in 5 feet of drained soil. Seepage and the high water table keep the areas constantly wet, but the water table remains below the surface throughout the year.

This land type is suited to range. Reclaimed areas on fans are suited to irrigated close-sown crops and hay. (Capability unit Vw-1, dryland; Wetland range site, 10- to 14-inch precipitation zone)

Alluvial land, wet (An).—This land type consists of loamy alluvium 36 to 60 inches deep over loose sand and gravel. It occurs in swales, shallow stream channels, and oxbows on flood plains, and on low terraces of river valleys. The most extensive areas are southwest of Laurel. The native vegetation is cattails, reedgrass, and sedges. Included in mapping are small areas of open water.

The available water capacity in drained areas is 5 to 10 inches. A permanent water table is at or within 3 feet of the surface. Mottling is prominent at all depths, and the 8-inch surface layer contains much raw or only partly decomposed organic matter. Plant roots penetrate only to the water table.

This land type is suited to range. Draining most areas is not practical, because outlets for open ditches and tiles are inadequate. (Capability unit Vw-1, dryland; Wetland range site, 10- to 14-inch precipitation zone)

Amherst Series

The Amherst series consists of well-drained, shallow, strongly sloping soils that are underlain by hard platy shale. These soils are on uplands. They occur on ridges that separate deep drainageways and on sides of knolls and hills. The native vegetation is grasses and low shrubs. Elevation ranges from 3,600 to 4,800 feet. The annual precipitation is 14 to 16 inches, the mean annual temperature is 44° F., and the frost-free season is 110 to 120 days. Associated with these soils are Maginnis and Absarokee soils on the uplands and Grail soils in the valleys.

In a typical profile, the surface layer is light brownish-gray loam about 2 inches thick. The subsoil, about 8 inches thick, is dark grayish-brown channery heavy loam in the upper part and brown channery light clay in the lower part. The substratum is very channery clay of which 75 percent, by volume, is laminated fragments of hard sandstone and shale. These fragments have thin clay films on their upper and lower faces. Depth to hard sandy shale is 16 inches.

Amherst soils are used for dryfarmed small grains and for range.

Typical profile of an Amherst channery clay loam, 4 to 7 percent slopes, 950 feet south and 450 feet east of the center of section 20, T. 3 N., R. 26 E.:

A1—0 to 2 inches, light brownish-gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abrupt boundary.

B1—2 to 5 inches, dark grayish-brown (10YR 4/2) channery heavy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure that breaks to moderate, fine, blocky; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; thin, patchy clay films on all ped faces; 15 to 25 percent, by volume, sandstone and shale fragments ¼ inch to 2 inches in diameter; clear boundary.

B2t—5 to 10 inches, brown (10YR 5/3) channery light clay, brown (10YR 4/3) when moist; weak, medium, prismatic structure that breaks to strong, fine, subangular blocky; hard when dry, friable when moist, sticky and plastic when wet; moderate continuous clay films on most ped faces and thick patchy clay films on some horizontal faces; 20 to 30 percent, by volume, shale and sandstone fragments; gradual boundary.

C&R—10 to 16 inches, very channery clay that is 60 to 75 percent, by volume, laminated fragments of hard sandstone and shale; fragments have thin clay films on upper and lower sides; interstices filled with clay.

R—16 inches, hard sandy shale.

The A horizon ranges from 4 to 6 in value when dry and from 2 to 3 when moist. Chroma is 2 or 3. The A horizon is loam, gravelly loam, and clay loam. Content of fragments ranges from 5 to 30 percent, by volume, in the A and B hori-

zons and from 35 to 75 percent in the C&R horizon. Depth to hard shale is 15 to 20 inches.

Amherst clay loam, 7 to 15 percent slopes (Ao).—This soil occurs on knolls, ridges, and the sides of drainageways on the uplands south of the Yellowstone River. The surface is smooth, and slope is dominantly 10 percent. Along the drainageways where slopes are more than 12 percent, stones as much as 15 inches in diameter are on the surface in some places. Included with this soil in mapping are spots of Maginnis soils.

This soil is well drained and has moderate permeability and rapid runoff. The available water capacity is 2 to 3 inches. The risk of water erosion is moderate. Stony spots in cultivated fields are droughty and difficult to seed.

About two-thirds of this soil is used for dryfarming, and the rest is used for grazing beef cattle. (Capability unit IVe–3, dryland; Silty range site, 15- to 19-inch precipitation zone)

Amherst-Maginnis channery clay loams, 4 to 7 percent slopes (Ap).—This complex occurs on smooth wide ridges between shallow drainageways and in narrow bands along deep drainageways. Slopes are dominantly 4 percent. The complex is 65 to 75 percent Amherst clay loam and 25 to 35 percent Maginnis channery clay loam. Each of these soils has a profile similar to that described as typical for its series. Cultivated areas of these soils have more shale and sandstone fragments on the surface than uncultivated areas. These fragments cover more than 50 percent of the surface in some spots of Maginnis soil. These spots of Maginnis soil are droughty, and the high percentage of fragments makes dryfarming difficult.

These soils are used mainly for dryfarming. Soils on the Crow Indian Reservation are used mostly for range. (Capability unit IVe–3, dryland; Silty range site, 15- to 19-inch precipitation zone)

Apron Series

The Apron series consists of deep, somewhat excessively drained, sloping to moderately steep soils on uplands. These soils formed in materials weathered from calcareous, light yellowish-brown sandstone. The native vegetation is sand reedgrass, yucca, skunkbush sumac, ricegrass, and needle-and-thread. Elevation ranges from 3,000 to 3,900 feet. Annual precipitation is 11 to 14 inches, the mean annual temperature is 45 to 47° F., and there are 115 to 130 frost-free days. These soils are associated with Worland and Travessilla soils in the northeast quarter of the county.

In a typical profile, the surface layer is light brownish-gray light fine sandy loam 2 inches thick. It is directly underlain by a substratum of pale-brown fine sandy loam and pale-yellow loamy very fine sand. Depth to soft or weakly consolidated sandstone is 60 inches.

Permeability is rapid, and the available water capacity is 5 to 7 inches. The risk of soil blowing is high. The organic-matter content is low, and the fertility is low to moderate.

These soils are used mostly for grazing beef cattle.

Typical profile of Apron fine sandy loam, 4 to 7 percent slopes, 575 feet west and 990 feet north of the center of section 31, T. 7 N., R. 31 E.:

A1—0 to 2 inches, light brownish-gray (10YR 6/2) light fine sandy loam, dark grayish brown (10YR 4/2) when moist; upper one-half inch very weak, medium, platy structure; below that depth weak, medium, crumb structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; calcareous; pH 7.5; abrupt, smooth boundary.

C1—2 to 8 inches, pale-brown (10YR 6/3) light fine sandy loam, dark grayish brown (10YR 4/2) when moist; very weak, coarse, prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; moderately calcareous; pH 8.0; diffuse boundary.

C2—8 to 14 inches, pale-brown (10YR 6/2) fine sandy loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; strongly calcareous; pH 8.5; diffuse boundary.

C3 -14 to 27 inches, pale-yellow (2.5Y 7/3) fine sandy loam, light yellowish brown (2.5Y 6/4) when moist; massive; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; some sandstone fragments less than ½ inch in diameter; very strongly calcareous; pH 8.5; diffuse boundary.

C4—27 to 60 inches, pale-yellow (2/5Y 7/3) loamy very fine sand, light yellowish brown (2.5Y 6/4) when moist; massive; soft when dry, friable when moist, nonsticky and nonplastic when wet; very strongly calcareous; pH 8.5.

The A horizon ranges from 10YR to 2.5Y in hue. In value this horizon is 5 or 6 when dry and 4 or 5 when moist. Chroma is 2 or 3. The A and C horizons range from fine sandy loam to loamy very fine sand. In some areas a few soft sandstone fragments occur in the lower C horizon.

Apron loamy fine sand, 4 to 7 percent slopes (Ar).—This soil occurs on undulating sandstone uplands in the north-central part of the county. Except for the surface layer of loamy fine sand, the profile of this soil is typical for the series. Included in mapping are 1- to 2-acre blowouts that have low sand dunes on their east side. The risk of soil blowing is very high. Drainageways are indistinct, and runoff is very slow.

This soil is used for grazing beef cattle. (Capability unit IVe–2, dryland; Sands range site, 10- to 14-inch precipitation zone)

Apron fine sandy loam, 4 to 7 percent slopes (As).—This soil occurs on undulating sandstone uplands in the northern half of the county. Individual areas range from 40 to 250 acres in size. This soil has the profile described as typical for the series.

Included with this soil in mapping are some Worland soils on crests of narrow ridges and on the sides of deep drainageways. Also included are spots of Apron loamy fine sand on gentle slopes on the east side of shallow blowouts that are scattered across the landscape. These blowouts are about a half acre in size. The risk of soil blowing is high to very high. Drainageways are indistinct, and surface runoff is slow. Cultivated and overgrazed areas have lost several inches of surface soil.

This soil is used mainly for grazing beef cattle. Areas once dryfarmed have been seeded to pasture and hay crops. (Capability unit IVe–2, dryland; Sandy range site, 10- to 14-inch precipitation zone)

Apron-Travessilla loamy fine sands, 7 to 15 percent slopes (At).—These soils occur on sandstone uplands that have wide ridges, low hills, and sandstone ledges and outcrops 10 to 20 feet thick. The complex is only in the northern half of the county. Slopes are dominantly 8 percent. The steepest slopes occur on the sides of drain-

ageways and below rock ledges. Included with these soils in mapping are blowouts about a quarter acre in size, and low dunes caused by soil blowing.

About 55 percent of this complex is Apron loamy fine sand, 30 percent is Travessilla loamy fine sand, and 15 percent is barren sandstone rock outcrop. Except for the loamy fine sand surface layer, each soil has the profile typical for its series. The Apron soil is on smooth ridges, low hills, and sides of shallow drainageways. The Travessilla soil and the rock outcrop are on the short irregular slopes of steep ridges and on the sides of narrow valleys.

These soils are suited only to range. (Capability unit VIe–2, dryland; Apron soil is in Sands range site, 10- to 14-inch precipitation zone; Travessilla soil is in Shallow Limy range site, 10- to 14-inch precipitation zone)

Arvada Series

The Arvada series consists of moderately well drained, nearly level to gently sloping, fine-textured soils on flood plains, terraces, and fans. These soils formed in mixed, stratified alluvium. The native vegetation is grasses, sagebrush, greasewood, and annual weeds. Elevation ranges from 2,900 to 4,000 feet. The annual precipitation is 13 to 15 inches, the mean annual temperature is 47° F., and the frost-free season is 115 to 130 days. Arvada soils are associated with Bone, Fort Collins, and Hydro soils.

In a typical profile, the surface layer is light-gray loam 4 inches thick. The subsoil is grayish-brown, pale-brown, and light brownish-gray clay 14 inches thick in the upper part and light-gray clay about 10 inches thick in the lower part. The calcareous substratum is light-gray light clay loam in the upper part and light brownish-gray, stratified loam and fine sandy loam in the lower part. The upper 6 to 10 inches of the substratum contains many light-gray seams of crystalline gypsum and other salts.

Permeability is very slow, and the available water capacity is about 7 inches. The organic-matter content is moderately low, and the fertility is moderate. Where cultivated, these soils are hard and cloddy when dry. When wet, the clods slake and form a glazed surface crust.

Arvada soils are used for dry and irrigated farming and for range.

Typical profile of Arvada clay loam, 1 to 4 percent slopes, near the center of section 11, T. 2 N., R. 23 E.:

A2—0 to 4 inches, light-gray (10YR 7/2) loam, grayish brown (10YR 5/2) when moist; weak, thin, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; noncalcareous; pH 7.5; abrupt boundary.

B21t—4 to 8 inches, grayish-brown (10YR 5/2) clay, dark brown (10YR 3/3) when moist; strong, medium, prismatic structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; moderately thick, continuous clay films on the faces of peds; noncalcareous; pH 7.8; clear, wavy boundary.

B22t—8 to 13 inches, pale-brown (10YR 6/3) clay, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure that breaks to strong, medium and fine, blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; moderately thick, continuous clay films on the faces of peds; noncalcareous; pH 7.9; gradual boundary.

B3ca—13 to 18 inches, light brownish-gray (2.5Y 6/2) clay, light olive brown (2.5Y 5/3) when moist; weak, medium, prismatic structure that breaks to strong, medium and fine, blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; strongly calcareous; many lime nodules; pH 9.0; gradual boundary.

B4cs—18 to 28 inches, light-gray (2.5Y 7.2) clay, light olive brown (2.5Y 5/3) when moist; weak, medium, blocky structure; very sticky and very plastic when wet; very strongly calcareous; pH 9.1; many seams and nests of gypsum and other salts; gradual boundary.

C1cs—28 to 36 inches, light-gray (2.5Y 7/2) light clay loam, light olive brown (2.5Y 5/3) when moist; massive; slightly hard when dry, firm when moist, sticky and plastic when wet; strongly calcareous; pH 9.2; many seams of gypsum and other salts; gradual boundary.

C2—36 to 60 inches, light brownish-gray (2.5Y 6/2) stratified loam and fine sandy loam, light olive brown (2.5Y 5/4) when moist; massive; soft when dry, friable when moist, nonsticky and nonplastic when wet; strongly calcareous; pH 7.9.

The A horizon ranges from 10YR to 5Y in hue and from 2 to 4 in chroma. In value the C horizon is 6 or 7 when dry and 5 or 6 when moist. The A2 horizon is 2 to 6 inches thick, and is silt loam, loam, or very fine sandy loam. The B horizon is 4 to 24 inches thick and has columnar, prismatic, or blocky structure. Depth to layer high in gypsum ranges from 10 to 20 inches. Depth to the B3ca horizon ranges from 10 to 14 inches. The pH in the B and C horizons ranges from 7.8 to 9.2.

Arvada clay loam, 0 to 1 percent slopes (Au).—This soil occurs on fans and terraces. Runoff is slow, and water collects in pits on the soil surface when rain is heavy or snow melts. Except for the texture of the surface layer, this soil has a profile similar to that described as typical for the series. Included with this soil in mapping are Bone soils that make up 10 to 20 percent of any area mapped.

This soil is used for dry and irrigated farming and for range. (Capability unit IVs–2, irrigated; VIs–1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Arvada clay loam, 1 to 4 percent slopes (Av).—This soil occurs on fans and terraces in large stream valleys. Slopes are dominantly 2 percent. This soil has the profile described as typical for the series. The thickness of the surface layer and the depth to the salt layer determine the amount and vigor of vegetation. The soil is nearly barren where the surface layer is less than 2 inches thick and the salt layer is at a depth of less than 8 inches. If this soil is cultivated, crops are stunted.

This soil is used for dry and irrigated farming and for range. Shallow-rooted small grains and hay grow best on irrigated soils. (Capability unit IVs 2, irrigated; VIs–1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Arvada clay loam, 4 to 7 percent slopes (Aw).—This soil is on fans, valley sides, and eroded terrace edges in small stream valleys. Slopes are dominantly 5 to 6 percent. The soil profile differs from the typical in that the clay loam surface layer is less than 2 inches thick and the salt layer in the upper substratum is not so prominent. Surface runoff is medium, and the risk of water erosion is moderate.

This soil is used mostly for range. (Capability unit VIs–1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Arvada-Bone silty clay loams, 0 to 1 percent slopes (Ax).—These soils occur on alluvial fans and terraces.

Included in mapping the breaks between terrace levels are soils that have slopes of 3 to 4 percent. These slopes are about 75 feet long.

About 60 percent of the unit is Arvada silty clay loam, and about 40 percent is Bone silty clay loam. The Bone soils occur in $\frac{1}{16}$- to $\frac{1}{4}$-acre patches that are nearly barren or have white salt crystals in the surface layer. The Arvada soils have normal grass cover. Each soil has a profile that differs from the typical in having a silty clay loam surface layer.

Surface runoff is slow. Much of the excess water from rain and snow collects on the patches of Bone soils and evaporates before it can enter the soil.

These soils are used for dry and irrigated farming and for range. (Capability unit VIIs–2, dryland; Arvada soil is in Silty range site, 10- to 14-inch precipitation zone; Bone soil is in Saline Upland range site, 10- to 14-inch precipitation zone)

Arvada-Bone clays, 0 to 1 percent slopes (Ay).—These soils are on fans and dry lakebeds north of the Yellowstone River. The unit is about 70 percent Arvada clay, 20 percent Bone clay, and 10 percent Vananda soils. Except for the clay surface layer, each soil has a profile similar to that described as typical for its series.

Nearly barren spots of Bone soil 15 to 100 feet wide contrast sharply with the well-grassed Arvada soil. In places the upper 2 or 3 inches of the Bone soil has been removed by soil blowing and the surface is pitted. Runoff is slow. Surface water collects in the pits when snow melts or rain is heavy. Most of this water evaporates and does not enter the soil.

These soils are suited to range. (Capability unit VIIs–2, dryland; Arvada soil is in Clayey range site, 10- to 14-inch precipitation zone; Bone soil is in Saline Upland range site, 10- to 14-inch precipitation zone)

Bainville Series

The Bainville series consists of well-drained, sloping to steep, calcareous soils that are 20 to 40 inches deep to shale. These soils formed in soft silty and loamy shale on eroded uplands. The native vegetation is grasses and forbs. Scattered pine, juniper, and cedar grow on north-facing slopes and in the deepest coulees. Elevation ranges from 2,900 to 4,200 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 130 days. Bainville soils are associated with Worland, Elso, Midway, Travessilla, and Cushman soils on the shale uplands and with McRae and Fort Collins soils in upland valleys.

In a typical profile, the surface layer is grayish-brown loam about 3 inches thick. It is directly underlain by grayish-brown heavy silt loam and light brownish-gray clay loam. Weathered shale begins at a depth of 30 inches. Many weathered shale chips are between depths of 22 and 30 inches.

These soils have moderate natural fertility and low content of organic matter. Permeability is moderate, and the available water capacity is 3 to 6 inches.

Bainville soils are well suited to range. Where these soils are dryfarmed, wheat and barley are grown in a crop-fallow system. In the northeastern part of the county, much of the acreage that was cultivated has been reseeded to grass.

Typical cultivated profile of Bainville loam, 2 to 7 percent slopes, 800 feet east of the SW. corner of section 15, T. 4 N., R. 30 E., 150 feet north of the road and 200 feet east of the stock pass:

Ap1—0 to 1 inch, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; moderate, fine, crumb structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; moderately calcareous; pH 8.4; abrupt boundary.

Ap2—1 to 3 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; very strongly calcareous; pH 8.4; abrupt, smooth boundary.

C1—3 to 22 inches, grayish-brown (2.5Y 5/2) heavy silt loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, blocky structure; hard when dry, friable when moist, slightly sticky and plastic when wet; very strongly calcareous; pH 8.6; gradual boundary.

C2—22 to 30 inches, light brownish-gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/3) when moist; strong, thick, platy structure; many weathered shale chips; pH 8.6; gradual boundary.

C3 -30 inches, weathered and unweathered shale.

The A horizon ranges from 2 to 5 inches in thickness and is loam or silt loam in texture. Depth to shale is 20 to 40 inches. The content of shale chips increases as depth increases.

Bainville loam, 2 to 7 percent slopes (Bo).—This soil is on undulating shale uplands between major valleys. It also occurs on tablelands that are crossed only by broad shallow drainageways. Slopes are dominantly 2 to 4 percent. The steeper and shorter slopes occur along well-established drainageways. Runoff is slow. In most cultivated areas, this soil has been damaged by soil blowing. The profile of this soil is the one described as typical for the series.

Included with this soil in mapping are small spots of gently sloping McRae soils on long slopes and in the heads of drainageways. In places on sharp ridgetops and the sides of deeper drainageways fragments of sandstone and semihard shale are on the surface.

This soil is used for dryfarming and for range. (Capability unit IVe–4, dryland; Silty range site, 10- to 14-inch precipitation zone)

Bainville loam, 7 to 15 percent slopes (Bc).—This soil occurs on uplands, mostly north of the Yellowstone River. In the landscape are ridges, knolls, and narrow drainageways. The drainageways branch from the larger stream valleys and are cut 15 to 50 feet below the ridges and knolls. Slopes are 7 to 10 percent on the ridgetops and 12 to 15 percent in the deep, narrow drainageways. Surface runoff is medium where the native vegetation has been destroyed or the soil is tilled.

Included with this soil in mapping, in the deep, narrow drainageways, are soils that have slopes of 15 to 20 percent. Also included are areas of Midway clay loam that make up 20 percent of the unit, and of coulee bottoms and outcrops of shale and sandstone that make up less than 10 percent. The Midway soil occurs on the lower sides and bottoms of the deeper drainageways. In most places a low sandstone ledge separates the Midway soil from the Bainville soil above it. In some places a thin band of Travessilla loam lies immediately above this ledge. The

rock outcrops mostly occur where narrow ridges and deep coulees intersect.

This soil is well suited to range. Small areas are dryfarmed. (Capability unit VIe–4, dryland; Silty range site, 10- to 14-inch precipitation zone)

Bainville-Elso complex, 15 to 35 percent slopes (Be).—This complex occurs on deeply dissected shale uplands southwest of Custer. Stream valleys 75 to 200 feet deep are cut into the uplands. The surface was once covered by thick deposits of gravel, but erosion has removed these deposits in most places. Only a few scattered narrow ridges covered with gravel remain. Except for these gravelly ridges, thicker tree cover, and fewer shale and sandstone outcrops, this complex resembles Bainville-Rock outcrop complex, 15 to 45 percent slopes.

This complex is 35 to 50 percent Bainville loam, 30 to 40 percent Elso clay loam, and 5 to 20 percent McRae and Heldt soils. In some places soils on gravel-capped ridges and sandstone and shale outcrops make up 1 to 10 percent of mapped areas. In a few areas the gravel from narrow ridges has spilled onto the slopes below for a distance of 75 to 100 feet.

Bainville loam occurs on the lower sides of valleys and the bottoms of narrow valleys where olive-gray clay crops out. The McRae and Heldt soils occur in 1- to 10 acre patches below the Bainville and Elso soils in the widest valleys. Shale and sandstone crop out along the valley rims and on narrow ridges at the intersection of deep drainageways.

The McRae soils have the gentlest slopes. The soils on ridgetops not capped with gravel have slopes of 15 to 30 percent. The soils on the sides of gravelly ridges have slopes of 30 to 35 percent. Also included are soils that have slopes of 35 to 40 percent. On the sides of the deepest valleys are soils that have slopes of 35 to 55 percent. In the channels of the main valleys, runoff is rapid and erosion is active.

These soils are used only for range. (Capability unit VIe–4, dryland; Thin Silty range site, 10- to 14-inch precipitation zone)

Bainville-Elso-Shale outcrop complex, 7 to 25 percent slopes (Bf).—This complex occurs on dissected uplands underlain by beds of clayey and loamy shale. In places thin sandstone layers form low ledges on valley sides. The main valleys and closely spaced tributary drainageways cut the area into a pattern of narrow ridges and deep coulees.

This complex is about 45 percent Bainville loam, 45 percent Elso clay loam, and 10 percent shale and sandstone outcrops and the barren sides of narrow coulees. The shale and sandstone outcrops are on the steep sides of large drainageways or at the intersection of deep coulees. Neither the Bainville nor the Elso soil occupies a fixed position in the landscape. Each soil has a profile similar to the one described as typical for its series.

Included with these soils in mapping are small areas of Worland, Cushman, Razor, and McRae soils. Also included are some scoria outcrops on the slopes of the Bull Mountains.

Slopes are uneven and from 50 to 175 feet long. The soils on smooth ridgetops have slopes of 7 to 10 percent slopes. The soils on the sides of narrow ridges and deep coulees have slopes of 10 to 25 percent. The outcrops of shale have slopes of 20 to 25 percent, and in some included areas slopes are 25 to 40 percent. Runoff is medium. Erosion is active only in the narrow coulees and around the shale outcrops.

The soils in this complex are suitable only for range. (Capability unit VIe–4, dryland; Thin Silty range site, 10- to 14-inch precipitation zone)

Bainville-Rock outcrop complex, 15 to 45 percent slopes (Bg).—This complex occurs on sandstone and shale uplands that have been deeply eroded and are cut by many coulees and dry stream valleys. The sandstone layers that separate the soft beds of shale are exposed on the sides of deep valleys. These sandstone layers are 20 to 50 feet thick. Where several of them are exposed, the landscape has the appearance of steps rising from the main valley floor to the high ridge that divides the valley from the next major valley.

About 30 percent of the complex is Bainville loam, and 40 percent is outcrops of nearly barren sandstone and shale and coulees that have slopes ranging from 35 percent to vertical. Included areas of Midway, Worland, and McRae soils make up 20 to 30 percent of the complex. The Midway and Worland soils occupy the same kind of positions as the Bainville soil. The McRae soil occurs on sides of valleys.

Bainville loam lies between shallow coulees, on smooth ridges that connect the sandstone outcrops, and on sloping shelves above and below steep rock ledges. Slopes are 15 to 30 percent. Throughout the complex, slopes range from 50 to 300 feet in length. Runoff is rapid during short, heavy summer rains, and erosion is active on the steep barren slopes.

These soils are used only for range. (Capability unit VIe–4, dryland; Thin Silty range site, 10- to 14-inch precipitation zone)

Bainville-Worland complex, 4 to 7 percent slopes (Bl).—The soils in this complex occur on undulating uplands. They are underlain by interbedded shale and sandstone. Near Broadview the complex consists of low, roughly parallel ridges that have crests 500 to 600 feet apart and troughs up to 25 feet deep. Because of this pattern of ridges and troughs, the surface appears wrinkled. In other parts of the county, slopes are uneven and there are low ridges and outcrops of sandstone and shale.

About 70 percent of the complex is Bainville loam, and about 30 percent is Worland fine sandy loam. The Worland soil generally is on the ridgetops. It is subject to moderate soil blowing. A few sandstone fragments are scattered on the narrow ridges of the Worland soil. The Bainville soil is in the swales or troughs between the ridges. Where drainageways are deep and the local relief is great enough to expose several of the sandstone layers, the soils occur in a random pattern. Each of these soils has a profile similar to the one described as typical for its series.

Slope is dominantly 4 percent. Slopes range from 200 to 300 feet in length. The slope is 7 percent along the deepest drainageways. Runoff is slow.

These soils are used for range. They are suitable for dryfarmed crops in areas where precipitation is highest. (Capability unit IVe–4, dryland; Bainville soil is in

Silty range site, 10- to 14-inch precipitation zone; Worland soil is in Sandy range site, 10- to 14-inch precipitation zone)

Bew Series

The Bew series consists of well-drained, nearly level to gently sloping, moderately fine textured soils that are more than 60 inches deep. The soils formed in clay and shale alluvium deposited on fans and terraces of river valleys. The native vegetation is mainly western wheatgrass, green needlegrass, and sagebrush. Elevation ranges from 3,000 to 3,500 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days.

In a typical profile, the surface layer is grayish-brown silty clay loam about 7 inches thick. The subsoil is light olive-brown and grayish-brown clay about 9 inches thick. The calcareous substratum is light olive-gray clay and heavy clay loam.

Runoff is slow, permeability is slow, and the available water capacity is 8 to 10 inches. The organic-matter content and fertility are moderate. Plant roots penetrate to a depth of more than 60 inches.

Bew soils are used for dry and irrigated farming and for range.

Typical profile of cultivated Bew silty clay loam, 0 to 1 percent slopes, 100 feet east and 50 feet north of the W¼ corner of section 32, T. 2 N., R. 27 E.:

Ap1—0 to 5 inches, grayish-brown (2.5Y 5/3) silty clay loam, light olive brown (2.5Y 3/3) when moist; moderate, medium and fine, granular structure; very hard when dry, friable when moist, sticky and plastic when wet; noncalcareous; pH 7.0; abrupt, smooth boundary.

Ap2—5 to 7 inches, grayish-brown (2.5Y 5/2) heavy silty clay loam, olive brown (2.5Y 3/4) when moist; weak, medium, blocky structure; very hard when dry, friable when moist, sticky and plastic when wet; noncalcareous; pH 7.0; abrupt boundary.

B21t—7 to 12 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/4) when moist; moderate, medium, prismatic structure that breaks to strong, fine, subangular blocky; very hard when dry, friable when moist, sticky and very plastic when wet; thin, continuous clay films on the faces of peds; noncalcareous; pH 7.5; gradual boundary.

B22t—12 to 16 inches, grayish-brown (2.5Y 5/2) clay, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure that breaks to moderate, fine and medium, subangular blocky; very hard when dry, friable when moist, sticky and plastic when wet; moderately thick, continuous clay films on all the faces of peds; moderately calcareous; a few lime nodules; pH 8.0; clear, wavy boundary.

C1ca—16 to 28 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) when moist; weak, medium, prismatic structure; very hard when dry, friable when moist, sticky and plastic when wet; moderately calcareous; common nodules of lime; pH 8.0; gradual boundary.

C2ca—28 to 32 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) when moist; massive; very hard when dry, friable when moist, sticky and plastic when wet; moderately calcareous; pH 8.0; common nodules of lime; gradual boundary.

C3—32 to 46 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) when moist; massive; very hard when dry, friable when moist, sticky and plastic when wet; moderately calcareous; pH 8.0; a few seams of gypsum; diffuse boundary.

C4—46 to 60 inches, light olive gray (5Y 6/2) heavy clay loam, olive gray (5Y 4/2) when moist; massive; very hard when dry, friable when moist, sticky and plastic when wet; moderately calcareous; pH 8.0; few pebbles.

The A horizon ranges from 2 to 7 inches in thickness. The B horizon ranges from 9 to 15 inches in thickness and is silty clay or clay. Depth to the Cca horizon is 12 to 16 inches.

Bew silty clay loam, 0 to 1 percent slopes (Bm).—This soil occurs on smooth terraces and alluvial fans in the Yellowstone River Valley and on the high gravel terraces that flank the valley. This soil occupies areas that are 10 to 150 acres in size. The soil profile is typical for the series. In places pebbles are scattered through the soil. Included in mapping are level soils that have a loam surface layer.

This soil is suited to irrigated sugar beets, dry beans, corn for silage, small grains, and hay. It is also suited to dryfarmed small grains and to range. (Capability unit IIs–1, irrigated; IIIs–3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Bew clay, 0 to 1 percent slopes (Bn).—This soil is on level terraces in the vicinity of Shepherd. Except for the clay surface layer, the profile is like that described as typical for the series. Surface runoff is slow. The risk of soil blowing is moderate.

This soil is suited to small grains, corn for silage, and hay and pasture. It is not well suited to sugar beets and dry beans. (Capability unit IIIs–1, irrigated; IIIs–3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Bew clay, 1 to 4 percent slopes (Bo).—This soil occurs on river terraces and alluvial fans on the southern border of the Comanche Basin. The areas are 10 to 20 acres in size. Slopes are dominantly 2 percent and 100 feet long. Except for the clay surface layer, the profile is similar to the one described as typical for the series. On the river terraces the soil is underlain by gravel at a depth of 48 inches. A few pebbles occur on this soil. Included in mapping are spots of nearly level Allentine soils.

Surface runoff is medium, and the risk of water erosion and soil blowing is moderate.

This soil is suited to irrigated small grains, corn for silage, and hay and pasture. Small areas are used for dryfarmed small grains and for range. (Capability unit IIIe–1, irrigated; IIIe–3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Bew-Allentine clays, 0 to 1 percent slopes (Br).—These soils occur on terraces and fans in the vicinity of Shepherd. Where old drainage channel scars cross the terraces, the soils may be only 40 to 60 inches deep over sand-filled gravel. Runoff is slow. The risk of soil blowing is moderate. In some areas a seasonal water table is at a depth of 48 to 84 inches.

About 55 percent of the complex is Bew clay and 35 percent is Allentine clay. Each soil has a profile similar to the one described as typical for its series. Each soil occurs in patches ½ acre to 5 acres in size. In cultivated fields the light brownish-gray Allentine soil contrasts sharply with the grayish-brown Bew soil. Included in mapping are Vananda soils, which make up about 10

percent of any mapped area. The Vananda soils are easily identified by their crusted surface.

These soils are suited to irrigated small grains, corn for silage, and hay and pasture. Some areas are dryfarmed. (Capability unit IIIs–1, irrigated; IIIs–3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Big Horn Series

The Big Horn series consists of deep, well-drained, nearly level soils on uplands. These soils formed in materials weathered in place from shale and sandstone. In places thin layers of alluvium that washed from higher areas have been deposited on the surface. The native vegetation is grasses and sagebrush. Elevation ranges from 2,900 to 3,900 feet. Annual precipitation is 11 to 14 inches, the mean annual temperature is about 47° F., and the frost-free season is 120 to 130 days. These soils are associated with Cushman and Bainville soils.

In a typical profile, the surface layer is light brownish-gray clay loam about 7 inches thick. The subsoil is grayish-brown to light yellowish-brown clay 41 inches thick. The lower part of the subsoil is calcareous. The substratum is light yellowish-brown sandy clay loam. Depth to shale and sandstone is 55 inches.

Runoff is slow, and the soils receive runoff from soils that lie above them. Permeability is moderately slow, and the available water capacity is 8 to 10 inches. Air, plant roots, and water easily penetrate the soil. Fertility is high and the organic-matter content is moderate. The risk of water erosion and soil blowing is low.

Around Broadview this soil is dryfarmed. Elsewhere in the county the soil is used for range.

Typical profile of cultivated Big Horn clay loam, 0 to 2 percent slopes, 900 feet west and 100 feet north of the SE. corner of section 10, T. 4 N., R. 25 E.:

Ap—0 to 7 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.1; abrupt, smooth boundary.

B21—7 to 9 inches, grayish-brown (10YR 5/2) heavy clay loam, dark brown (10YR 3/3) when moist; strong, medium, platy structure; hard when dry, firm when moist, sticky and plastic when wet; noncalcareous; pH 7.0; clear, smooth boundary.

B22t—9 to 19 inches, yellowish-brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) when moist; weak, fine, prismatic structure that breaks to strong, fine, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; thick, continuous clay films on all faces of peds; noncalcareous; pH 7.0; clear, wavy boundary.

B23ca 19 to 37 inches, light yellowish-brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/4) when moist; strong, fine, blocky structure; very hard when dry, firm when moist, very sticky and very plastic when wet; thick to moderately thick, continuous clay films on horizontal faces and thick, continuous clay films on vertical faces of peds; moderately calcareous; pH 8.2; common threads and nodules of lime; gradual boundary.

B3—37 to 48 inches, light yellowish-brown (2.5Y 6/4) light clay, light olive brown (2.5Y 5/4) when moist; weak to moderate, medium, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; thin, continuous clay films on all ped faces and some patches of moderately thick clay films on the vertical faces; moderately calcareous; common threads of lime; pH 8.2; gradual, wavy boundary.

C1—48 to 55 inches, light yellowish-brown (2.5Y 6/4) heavy sandy clay loam, light olive brown (2.5Y 5/4) when moist; massive; slightly hard when dry, friable when moist, sticky and plastic when wet; moderately calcareous; pH 8.4; gradual boundary.

C2—55 inches, shale and sandstone.

The A horizon ranges from 4 to 7 inches in thickness and contains many bleached and unstained sand grains. Where undisturbed, Big Horn soils have a loam surface layer. The B horizon is heavy clay loam or clay and is 20 to 45 inches thick. It contains light-gray lime mottles and threads in the lower part.

Big Horn clay loam, 0 to 2 percent slopes (Bs).—This soil occurs in swales and in heads of drainageways on undulating uplands north of the Yellowstone River. Slope is 2 percent in the deepest drainageways.

This soil is used for dryfarmed winter wheat and barley. (Capability unit IIIc–1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Bone Series

The Bone series consists of deep, well-drained, nearly level to moderately sloping, saline-alkali soils on fans, terraces, and dry lakebeds. These soils formed in fine-textured alluvium that contains salts. The native vegetation is sparse and consists of inland saltgrass, greasewood, saltbush, western wheatgrass, sagebrush, and weeds. Elevation ranges from 3,000 to 4,000 feet. The annual precipitation ranges from 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days. These soils are associated with Arvada and Vananda soils.

In a typical profile, the surface layer is light brownish-gray very fine sandy loam 1 inch thick. The upper part of the subsoil is grayish-brown and light olive-brown silty clay 4 inches thick, and the lower part is light olive-brown silty clay and clay 47 inches thick. The lower part contains many salt threads and coarse crystals. The substratum is stratified clay loam, loam, and fine sandy loam.

Permeability is very slow, and the available water capacity is 7 to 9 inches in 5 feet of soil. Fertility is moderate, and the organic-matter content is low.

Bone soils are suited to range. To reclaim these soils by irrigation is slow and expensive. Because of surface crusting and the toxic effects of the salts, it is difficult to reseed areas where natural vegetation is destroyed by trampling or overgrazing.

Typical profile of Bone silty clay, 0 to 1 percent slopes, 125 feet north and 275 feet west of the E¼ corner of section 25, T. 2 N., R. 29 E.:

A2—0 to 1 inch, light brownish-gray (2.5Y 6/2) very fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; vesicular; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many grains of clear silt and very fine sand; noncalcareous; abrupt boundary.

B2t—1 to 3 inches, grayish-brown (2.5Y 5/2) silty clay, olive brown (2.5Y 4/3) when moist; moderate, medium, columnar structure that breaks to strong, very fine, subangular blocky; extremely hard when dry, firm when moist, sticky and very plastic when wet; moderately thick, continuous clay films on faces of peds; tops of columns covered with continuous frosting of bleached, light-gray (2.5Y 7/2) silica that extends

about 1 inch down the vertical faces of peds; noncalcareous; pH 8.0; clear, wavy boundary.

B3—3 to 5 inches, light olive-brown (2.5Y 5/3) silty clay, olive brown (2.5Y 4/3) when moist; moderate, fine and very fine, subangular blocky structure; extremely hard when dry, firm when moist, sticky and plastic when wet; strongly calcareous; pH 9.2; clear, smooth boundary.

C1cs—5 to 14 inches, light olive-brown (2.5Y 5/3) silty clay, olive brown (2.5Y 4/3) when moist; moderate, fine and medium, granular structure; hard when dry, friable when moist, very sticky and very plastic when wet; strongly calcareous; many seams and nests of gypsum and other salts; pH 8.8; gradual boundary.

C2cs—14 to 25 inches, light olive-brown (2.5Y 5/3) silty clay, olive brown (2.5Y 4/3) when moist; massive; extremely hard when dry, firm when moist, very sticky and very plastic when wet; strongly calcareous; a few seams and nests of gypsum; pH 9.4; gradual boundary.

C3—25 to 52 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) when moist; massive; very hard when dry, very firm when moist, very sticky and very plastic when wet; weakly calcareous; pH 9.6; gradual boundary.

C4—52 to 62 inches, stratified clay loam, loam, and fine sandy loam.

In cultivated fields the Ap horizon is a mixture of the A2 and B2t horizons. A glazed, vesicular crust having clear grains of silt and sand forms on the soil as it dries. The B2t horizon is 2 to 4 inches thick and 35 to 50 percent clay. The pH ranges from 8.0 in the B2t horizon to 9.6 in the C horizon. The amount of visible gypsum and salt decreases below a depth of 10 inches. Below a depth of 48 inches, the C horizon has strata of sandy loam and loam in some places.

Bone silty clay, 0 to 1 percent slopes (Bt).—This soil occurs on river terraces, on fans, and in dry lake basins in the northwest quarter of the county. The soil profile is typical for the series. Where salts are concentrated at the soil surface, the structure is granular. The salt spots appear as low scattered mounds. Surface runoff is slow, but most of the water evaporates from the surface and does not enter the soil. Some irrigated areas have a seasonal water table within 5 feet of the surface.

This soil is used for range. Where subsurface drainage is good, the soil can be reclaimed by leveling and leaching with irrigation water. Reclaimed soil can be used for hay. (Capability unit VIIs–2, dryland; Saline Upland range site, 10- to 14-inch precipitation zone)

Bone silty clay, 1 to 6 percent slopes (Bu).—This soil occurs on edges of fans where they join level stream terraces. Nearly all of this soil is north and west of Shepherd. It has medium surface runoff and is crossed by deeper drainageways than Bone silty clay, 0 to 1 percent slopes. The profile is like the one typical for the series, except that water seepage from irrigation canals has increased to above normal the amount of salt in the surface layer.

Slope is dominantly 3 percent. Steeper slopes occur along the narrow drainageways, 3 to 10 feet deep, that cut through the upper part of the fans. The risk of water erosion is moderate.

This soil is used mostly for range. (Capability unit VIIs–2, dryland; Saline Upland range site, 10- to 14-inch precipitation zone)

Bone clay, 0 to 1 percent slopes (Bv).—This soil occurs on fans and terraces along Crooked Creek west of Shepherd, and in the dry lake basin northwest of Acton. The profile is like the one typical for the series, except that there is more clay in all layers. Surface runoff is slow, but nearly all of the water evaporates from the soil surface. Included in mapping are spots of Arvada soils.

This soil is used for grazing sheep and beef cattle. (Capability unit VIIs–2, dryland; Saline Upland range site, 10- to 14-inch precipitation zone)

Clapper Series

The Clapper series consists of deep, strongly sloping to moderately steep, well-drained, very gravelly loam soils on the edges of high terraces and fans built from older eroded terraces. The native vegetation consists of short and mid grasses and shrubs. Elevation ranges from 3,000 to 3,800 feet. The annual precipitation is 11 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 118 to 129 days. These soils are associated with Shorey, Keiser, and Toluca soils on the older gravel terraces throughout the county.

In a typical profile, the surface layer is grayish-brown gravelly loam about 3 inches thick. It is directly underlain by the substratum, which extends to a depth of 60 inches. The substratum is light brownish-gray gravelly loam in the upper part and pale-yellow very gravelly loam in the lower part. The substratum has a 6-inch layer of white lime at a depth of 7 inches. Pebbles in this layer are coated with lime.

Permeability is moderate, and the available water capacity is 4 to 5 inches. The calcareous substratum is very susceptible to soil blowing and is low in fertility.

Clapper soils are used for dryfarming and for range.

Typical profile of Clapper gravelly loam, 7 to 15 percent slopes, 1,300 feet west and 475 feet south of the E¼ corner of section 33, T. 1 S., R. 24 E.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) gravelly loam, dark grayish brown (2.5Y 4/2) when moist; weak, fine, crumb structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; 25 percent gravel, by volume; moderately calcareous; pH 8.4; clear, wavy boundary.

C1—3 to 7 inches, light brownish-gray (2.5Y 6/2) gravelly heavy loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; 25 percent gravel, by volume; moderately calcareous; pH 8.4; gradual, wavy boundary.

C2ca—7 to 13 inches, white (2.5Y 8/2) gravelly loam, pale yellow (2.5Y 7/3) when moist; weak, thick, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; 25 percent gravel, by volume; very strongly calcareous; pH 8.4; gradual boundary.

C3—13 to 23 inches, pale-yellow (2.5Y 8/3) very gravelly heavy loam, pale yellow (2.5Y 7/3) when moist; massive; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; 50 percent gravel, by volume; very strongly calcareous; pH 8.4; gradual boundary.

C4—23 to 60 inches, pale-yellow (2.5Y 8/3) very gravelly heavy loam, pale yellow (2.5Y 7/3) when moist; massive; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; 55 percent gravel, by volume; very strongly calcareous; pH 8.4.

As much as 40 percent of the A horizon is gravel in some areas. The amount of gravel generally increases with depth.

Some soils have lenses of nearly clean gravel mixed with loamy material. In value the C horizon ranges from 6 to 8 when dry and from 4 to 7 when moist. The chroma is 2 or 3.

Clapper clay loam, 15 to 35 percent slopes (Ca).—This soil occurs in 40- to 200-acre areas along Pryor Creek and on the high, smooth bedrock plain that forms the valley rim to the west. A mantle of gravel and wind-deposited material originally covered all the underlying bedrock. Deep drainageways cut through the gravel mantle and into the underlying bedrock. Shale and platy sandstone crop out on the bottoms and sides of these drainageways.

The profile of this soil is similar to the one typical for the series, except that the surface layer is dark grayish-brown clay loam, the lime layer in the subsoil is not distinct, the pebbles mixed with the soil are only semi-rounded, and there are a few cobblestones and small stones. Included in mapping are Absarokee clay loam in wide, smooth, well-grassed drainageways and Danvers silty clay loam on wide ridges. These soils make up 5 to 15 percent of any mapped area.

Slopes are short and dominantly 20 percent. Slopes are 6 percent on ridgetops. Slopes of 20 to 35 percent occur in narrow valleys cut into the underlying bedrock. Runoff is rapid, and the risk of water erosion is high.

This soil is used only for grazing beef cattle. (Capability unit VIe–4, dryland; Thin Silty range site, 15- to 19-inch precipitation zone)

Clapper gravelly loam, 7 to 15 percent slopes (Cg).—This soil occurs on deeply eroded gravel terraces and fans and the edges of main drainageways along the Yellowstone River Valley and Pryor Creek. Closely spaced drainageways 10 to 25 feet deep are separated by narrow ridges and mounds. The profile of this soil is typical for the series. Slopes are less than 200 feet long and dominantly 10 to 15 percent. Slopes of 7 to 9 percent occur on the wider mounds and ridges. Runoff is medium, and the risk of water erosion is moderate.

This soil is used for dryfarming and for range. (Capability unit VIe–4, dryland; Thin Silty range site, 10- to 14-inch precipitation zone)

Cushman Series

The Cushman series consists of well-drained, medium-textured, gently sloping to moderately sloping soils that are 20 to 40 inches deep over sandstone and shale. These soils formed on uplands. The native vegetation is mostly needle-and-thread, sagebrush, blue grama, and winterfat. Elevation ranges from 3,000 to 3,900 feet. The annual precipitation is 11 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 115 to 130 days. These soils are associated with Bainville, Razor, and Big Horn soils on the smooth uplands in the northern half of the county.

In a typical profile, the surface layer is grayish-brown and brown loam 4 inches thick. The subsoil is olive-brown and light brownish-gray clay loam 9 inches thick. The calcareous substratum is light-gray loam and light yellowish-brown sandy loam. Depth to hard sandstone is 28 inches. The substratum contains many light-gray specks of lime, and partly weathered shale and sandstone chips occur in the lower part.

Permeability is moderately slow, and the available water capacity is 4 to 6 inches. Fertility is moderate, and organic-matter content is medium to low.

These soils are used for dryfarmed small grains and hay and for range.

Typical profile of Cushman loam, 1 to 4 percent slopes, 100 feet north of road center, approximately 325 feet west of the S¼ corner of section 26, T. 1 S., R. 23 E.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, platy structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; neutral; pH 7.3; clear, smooth boundary.

AB—2 to 4 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; neutral; pH 7.3; gradual, wavy boundary.

B2t—4 to 11 inches, olive-brown (2.5Y 4/3) clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure; very hard when dry, firm when moist, sticky and plastic when wet; thin, patchy clay films on ped faces; neutral; pH 7.3; clear, wavy boundary.

B3—11 to 13 inches, light brownish-gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure; hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 7.8; a few white (2.5Y 8/1) lime mottles; gradual, wavy boundary.

C1ca—13 to 23 inches, light gray (2.5Y 7/2) loam, light yellowish brown (2.5Y 6/3) when moist; moderate, medium and fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; a few sandstone fragments; many white (2.5Y 8/1) lime mottles; strongly calcareous; pH 8.4; clear, wavy boundary.

C2—23 to 28 inches, light yellowish-brown (2.5Y 6/3) light sandy loam, light olive brown (2.5Y 5/4) when moist; platy structure; hard when dry, friable when moist, slightly sticky when wet; about 60 percent, by volume, is thin sandstone fragments; strongly calcareous; pH 8.4; gradual, wavy boundary.

R—28 inches, hard sandstone.

The profile ranges from 10YR to 2.5Y in hue. In value the B horizon ranges from 4 to 6 when dry and is 4 to 3 when moist. The B horizon is 5 to 9 inches thick and is 25 to 35 percent clay. Depth to underlying shale and sandstone is 20 to 40 inches.

Cushman-Bainville loams, 1 to 4 percent slopes (Ch).—These soils occur on gently undulating shale uplands between the larger stream valleys in the northern half of the county.

Slopes are dominantly 3 percent on Bainville loam and 1 percent on Cushman loam. Surface runoff is slow, and the risk of soil blowing is slight.

About 60 percent of the unit is Cushman loam, and about 40 percent is Bainville loam. The Cushman soil occupies concave slopes and shallow drainageways, and the Bainville soil occupies the ridges and knolls. In cultivated fields the grayish-brown surface of the Cushman soil is sharply contrasted with the light brownish-gray surface of the Bainville soil. Each kind of soil has a profile similar to the one described as typical for its series. Included with these soils in mapping are small areas of Big Horn soils in swales and on slopes of less than 2 percent.

These soils are used for dryfarmed small grains and hay and for range. (Capability unit IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Cushman-Bainville loams, 4 to 7 percent slopes (Cm).—These soils occur on undulating shale uplands north of the Yellowstone River Valley. Slopes are about 4 percent on the Cushman soils and 4 to 7 percent on the Bainville soils. Runoff is medium, and the risk of soil blowing is moderate.

The complex is 55 percent Cushman loam and 45 percent Bainville loam. Cushman loam occupies the troughs between ridges and knolls and the lower part of long slopes. Bainville loam is on crests and tops of knolls and ridges and on sides of deep narrow drainageways. Each soil has a profile similar to that typical for its series, but the subsoil of the Cushman loam is only 4 to 5 inches thick on the steeper slopes. Thin stones of shale and sandstone occur on the surface of the sharp, narrow ridges. Included in mapping are Worland soils on ridgetops.

The soils are used for dryfarmed small grains and hay and for range. (Capability unit IIIe-5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Danvers Series

The Danvers series consists of deep, well drained, moderately fine textured, gently to strongly sloping soils. These soils formed in very calcareous, silty alluvium deposited on high terraces by streams and wind. The native vegetation is grasses and shrubs. Elevation ranges from 3,100 to 4,800 feet. The annual precipitation is 14 to 16 inches, the mean annual temperature is 42 to 44° F., and the frost-free season is 115 to 125 days.

In a typical profile, the surface layer is grayish-brown silty clay loam 6 inches thick. The subsoil is 13 inches thick. It is dark grayish-brown and brown silty clay in the upper part and light brownish-gray clay loam in the lower part. Small round masses of lime have collected in the lower part of the subsoil. The substratum is very strongly calcareous, white and light-gray clay loam. Fine particles of lime occur throughout the substratum. Sand and gravel occur at a depth of 60 inches (fig. 5).

Permeability is moderately slow, and the available water capacity is 8 to 10 inches. The risk of soil blowing is low. Fertility is high.

Danvers soils are used for dryfarmed small grains and alfalfa and for range.

Typical profile of cultivated Danvers silty clay loam, 2 to 4 percent slopes, in a field 600 feet north and 175 feet west of SW. corner of section 3, T. 1 N., R. 29 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, very fine, granular structure; hard when dry, firm when moist, sticky and plastic when wet; noncalcareous; pH 7.3; abrupt, smooth boundary.

B21t—6 to 11 inches, dark grayish-brown (10YR 4/2) heavy silty clay, dark brown (10YR 3/3) when moist; strong, medium, prismatic structure that breaks to strong, medium and fine, blocky; hard when dry, very firm when moist, very sticky and very plastic when wet; moderately thick, continuous clay films on ped faces; noncalcareous; pH 7.3; clear, wavy boundary.

B22t—11 to 13 inches, brown (10YR 5/3) silty clay, dark brown (10YR 4/3) when moist; strong, medium and fine, prismatic structure that breaks to moderate, medium, blocky; moderately thick clay films on ped faces; pH 7.3; clear, wavy boundary.

Figure 5.—**Profile of a Danvers silty clay loam exposed in a roadbank.**

B3ca—13 to 19 inches, light brownish-gray (10YR 6/2) heavy clay loam, pale brown (10YR 6/3) when moist; weak, medium, prismatic structure that breaks to weak, medium, blocky; hard when dry, firm when moist, sticky and plastic when wet; strongly calcareous; common lime nodules; pH 7.8; clear, wavy boundary.

C1ca—19 to 26 inches, white (10YR 8/1) light clay loam, very pale brown (10YR 7/3) when moist; massive; slightly hard when dry, friable when moist, sticky and plastic when wet; very strongly calcareous; pH 8.4; clear, irregular boundary.

C2—26 to 60 inches, light-gray (10YR 7/2) light clay loam, pale brown (10YR 6/3) when moist; massive; slightly hard when dry, friable when moist, sticky and plastic when wet; strongly calcareous; pH 8.4.

Where undisturbed, the A horizon is silt loam 2 to 3 inches thick. The B horizon is 9 to 15 inches thick. The C horizon ranges from 10YR to 2.5Y in hue; in value, it ranges from 6 to 8 when dry and from 5 to 7 when moist. Chroma ranges from 1 to 3. A few pebbles are scattered on the surface in some areas. Depth to underlying sand and gravel is 48 to 72 inches.

Danvers silty clay loam, 2 to 4 percent slopes (Da).—This soil occurs on gently undulating terraces that are crossed by broad, shallow drainageways. It occupies areas less than 80 acres in size. The soil profile is typical for the series. In cultivated fields, on narrow ridges, and on

the sides of deep drainageways, the surface soil is light brownish gray. A thin layer of silt loam occurs where wind-laid deposits have thickened the surface layer to 7 or 8 inches. Spots as much as three-quarters acre in size occur where 5 to 20 percent of the surface is covered with pebbles. Included with this soil in mapping are gently sloping Shaak soils.

Slopes are dominantly 2 to 3 percent. Runoff is slow, and water generally enters the soil on the gentle slopes. The risk of water erosion is low.

This soil is used for dryfarmed small grains and alfalfa and for range. (Capability unit IIe-2, dryland; Silty range site, 15- to 19-inch precipitation zone)

Danvers silty clay loam, 8 to 15 percent slopes (Dn).—This soil occurs in small scattered areas, normally in bands along terrace edges or on the eroded parts of gravel terraces. In most places the soil is between gently sloping Danvers soils and Hilly gravelly land. The profile is similar to that described as typical, except that it has a thinner surface layer and subsoil, has more pebbles in all layers, and is less than 60 inches deep over sand and gravel. In cultivated fields the plow layer includes all the subsoil, and in some places the light-gray substratum has been plowed to the surface. Where drainageways intersect, enough gravel is on the surface to interfere with tillage. Slopes are dominantly 10 percent, but in some included areas they are 5 to 8 percent. Runoff is medium, and the risk of water erosion is moderate in drainageways.

This soil is used for dryfarmed small grains and for range. (Capability unit IVe-3, dryland; Silty range site, 15- to 19-inch precipitation zone)

Danvers-Judith complex, 7 to 15 percent slopes (Dr).—The soils in this complex occur on the breaks between terraces and along the edges of deep drainageways that cross gravel terraces. These soils are on the east side of Pryor Creek at the south county line.

About 75 percent of the complex is Danvers silty clay loam, and 25 percent is Judith loam. The Danvers soil has 7 to 12 percent slopes, and the Judith soil has 10 to 15 percent slopes. Pebbles are common on the surface of the Judith soil. Each soil has a profile similar to the one typical for its series.

Surface runoff is medium, and the risk of erosion is moderate. In moderately eroded spots of cultivated Judith soil the light-colored substratum is exposed.

These soils are used for dryfarming and for range. (Capability unit IVe-3, dryland; Silty range site, 15- to 19-inch precipitation zone)

Danvers-Shaak clay loams, 7 to 15 percent slopes (Ds).—These soils occur in a pattern of parallel strips on deeply dissected terraces. The pattern consists of closely spaced, convex ridges separated by concave drainageways 20 to 25 feet deep. Danvers clay loam occupies the ridges, and Shaak clay loam occupies the drainageways. Slope is dominantly 12 percent. All the acreage is between Pryor Creek and the escarpment that separates the valley of Pryor Creek from the high bedrock plains to the west.

About 65 percent of the complex is Danvers soil, and 35 percent is Shaak soil. Both kinds of soil have a clay loam surface layer. From 15 to 30 percent of the surface of the Danvers soil is covered with hard, angular, sandstone cobblestones. The Shaak soil contains more sand particles than is normal for its series. Soils that have thinner than normal surface and subsoil layers occur on the strongest slopes; where these soils are tilled, light-colored, limy spots occur.

These soils are used for dryfarming and for range. (Capability unit IVe-3, dryland; Silty range site, 15- to 19-inch precipitation zone)

Elso Series

The Elso series consists of well-drained, moderately sloping to moderately steep, calcareous soils that are less than 20 inches deep. These soils formed in soft shale on uplands. The native vegetation is mainly bluebunch and western wheatgrass, needle-and-thread, threadleaf sedge, sagebrush, and blue grama. Juniper, pine, and skunkbush sumac trees grow on the steepest slopes. Elevation ranges from 2,900 to 4,200 feet. The annual precipitation is 11 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 130 days. Elso soils are associated with Bainville soils on the uplands and Lohmiller soils in upland valleys.

In a typical profile, the surface layer is light yellowish-brown light clay loam 2 inches thick. The substratum is light yellowish-brown clay loam and pale-olive light silty clay loam. Many soft weathered shale chips are in the lower part of the substratum. Depth to shale is 12 inches.

Permeability is moderate, and the available water capacity is 2 to 3 inches. Natural fertility is moderate to low, and the organic-matter content is low.

Elso soils are used for dryfarmed small grains and for range.

Typical profile of Elso clay loam, 4 to 7 percent slopes, about one-sixth mile south of the NE. corner of section 21, T. 4 N., R. 30 E.:

A1—0 to 2 inches, light yellowish-brown (2.5Y 6/3) light clay loam, light olive brown (2.5Y 5/4) when moist; moderate, very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; moderately calcareous; pH 8.4; clear, smooth boundary.

C1—2 to 5 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/4) when moist; structure is strong, very fine, blocky and weak, thin, platy; hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 8.4; gradual, wavy boundary.

C2—5 to 12 inches, pale-olive (5Y 6/3) light silty clay loam, olive (5Y 5/3) when moist; moderate, medium, platy structure; hard when dry, firm when moist, sticky and plastic when wet; many partly weathered shale chips; moderately calcareous; pH 8.4; gradual, wavy boundary.

C3—12 inches, gray and pale-yellow, partly weathered, platy shale.

Elso soils range from 2.5Y to 5Y in hue. The chroma is 2 or 3. The C horizon is 10 to 35 percent clay. Roots penetrate through fracture planes to a depth of 24 inches.

Elso clay loam, 4 to 7 percent slopes (Ec).—This soil occurs on the uplands on low, smooth divides at the heads of major drainageways. The soil profile is typical for the series. Included with this soil in mapping are small spots of nearly level Razor soils on slopes between low ridges and at the heads of shallow drainageways.

Slopes are dominantly 6 percent. Some slopes of 10 percent occur on high steep hills and deep drainageways

where local relief reaches a maximum of 25 feet. Surface runoff is medium, and the risk of water erosion is moderate.

This soil is used mostly for range. Where precipitation is highest, small grains are dryfarmed in a crop-fallow system. (Capability unit IVe-4, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Elso clay loam, 7 to 15 percent slopes (El).—This soil occurs on shale uplands where water erosion has carved a pattern of closely spaced drainageways separated by narrow ridges. This soil normally lies in a band along the sides of a major valley, and the band extends up the tributary drainageways for several hundred feet. The soil profile is similar to that typical for the series.

Included with this soil in mapping are small spots of shale outcrops and of Razor, Heldt, and Lohmiller soils. The Razor soil is gently sloping and lies between low ridges and at the heads of drainageways. The Heldt and Lohmiller soils occur in the widest drainageways in areas ½ to 2 acres in size. Shale outcrops make up as much as 10 percent of mapped areas. Outcrops occur at the junction of deep drainageways and on slopes facing the main valley. Some sandstone ledges 6 to 12 inches thick occur with the shale outcrops. Also present are mixed sandstone and shale ledges 60 to 96 inches thick.

Slopes are dominantly 10 percent, but in some included areas they are as much as 40 percent. These steeper areas are in the deep drainageways and around shale outcrops and ledges. Local relief ranges from 20 to 40 feet. Surface runoff is medium, and the risk of water erosion is high.

This soil is used for range. (Capability unit VIe-4, dryland; Clayey range site, 10- to 14 inch precipitation zone)

Elso clay loam, 15 to 60 percent slopes (Eo).—This soil is on steep valley rims, buttes, and hills that form drainage divides between major valleys. This soil does not include sandstone and shale ledges. Slopes are dominantly 15 to 30 percent on smaller, isolated hills and 45 to 60 percent along the rims of the main valleys. Slopes are as much as 200 feet long. The local relief ranges from 30 to 150 feet. Runoff is rapid, and the risk of water erosion is very high on the steeper slopes. Both hill and gully erosion are evident in most areas.

This soil is used only for range. (Capability class VIe-4, dryland; Thin Clayey range site, 10- to 14-inch precipitation zone)

Elso-Lohmiller complex, 15 to 35 percent slopes (Es).—This complex occupies large areas in the wide valleys that drain the shale uplands north of the Yellowstone River. Elso clay loam is on ridges and knolls, and Lohmiller clay loam is on the surrounding fans and valley slopes. The drainage network consists of a main channel of an intermittent stream and many steep tributary coulees, gullies, and drainageways.

The complex is 35 percent Elso soil and 25 percent Lohmiller soil. Each soil has a profile similar to the one described as typical for its series. About 30 percent of each area consists of eroded coulees and drainageways and steep edges of fans along the main channel of an intermittent stream. About 10 percent of each mapped area is shale outcrop.

Slopes of the Lohmiller soil are about 15 percent, and those of the Elso soil are 15 to 25 percent. Slopes of 30 to 35 percent occur on the fan edges and along the deep drainageways. Local relief is 25 to 50 feet. Runoff is rapid, and erosion is active in the large gullies and coulees.

These soils are suited to range. (Capability unit VIe-4, dryland; Elso soil is in Thin Clayey range site, 10- to 14-inch precipitation zone; Lohmiller soil is in Clayey range site, 10- to 14-inch precipitation zone)

Farland Series

The Farland series consists of deep, well-drained, nearly level to gently sloping silty soils that formed in alluvium that has been reworked by wind. The native vegetation is grasses and sagebrush. Elevation ranges from 3,400 to 3,700 feet. The annual precipitation is 13 to 15 inches, the mean annual temperature is 42 to 44° F., and the frost-free season is about 125 days. These soils are associated with Lambert and Hopley soils.

In a typical profile, the surface layer is grayish-brown silt loam 6 inches thick. The plow layer is a mixture of the original surface layer and the upper 4 inches of the subsoil. The subsoil is grayish-brown silty clay loam 8 inches thick. The calcareous substratum is light-gray silt loam several feet thick. Depth to shale is more than 60 inches.

Permeability is moderate, and the available water capacity is 10 to 12 inches. The organic-matter content and natural fertility are high. The risk of soil blowing and water erosion is low.

These soils are used for wheat and barley dryfarmed in a crop-fallow system. Small areas are used for grazing.

Typical profile of cultivated Farland silt loam, 0 to 4 percent slopes, about 1,500 feet north of the NE. corner of section 20, T. 2 S., R. 25 E.:

Ap1—0 to 2 inches, grayish-brown (10YR 5/2) light loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, granular structure; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; noncalcareous; pH 7.4; abrupt, smooth boundary.

Ap2—2 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; cloddy; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.4; abrupt, smooth boundary.

B2t—6 to 11 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, prismatic structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; thin, continuous clay films on the faces of peds; noncalcareous; pH 7.4; gradual, wavy boundary.

B3ca—11 to 14 inches, light brownish-gray (10YR 6/2) heavy silt loam, grayish brown (10YR 5/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; very strongly calcareous; pH 8.4; gradual boundary.

C—14 to 60 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; very strongly calcareous; pH 8.4.

Farland soils range from 10YR to 2.5Y in hue. In value the C horizon is 6 or 7 when dry and 5 or 6 when moist. Depth to the B3ca horizon is 8 to 12 inches.

Farland-Lambert silt loams, 0 to 4 percent slopes (Fa).—These soils occur on gently undulating uplands. Farland silt loam makes up about 70 percent of the complex, and Lambert silt loam makes up 30 percent. Each soil has a profile similar to that typical for its series.

It is not practical to separate these soils on the soil map, but they can be identified by their position. The Farland soil is nearly level and in swales. The Lambert soil occurs on the crests of low ridges. In cultivated fields the Lambert soil appears as light-colored spots.

Included with these soils in mapping are patches that have pebbles on the surface and a loam or very fine sand loam surface layer. These patches occur with the Lambert soil on the narrow crests of the higher ridges.

Slopes are dominantly 0 to 3 percent on the Farland soil and 3 to 4 percent on the Lambert soil. Runoff is slow. The risk of soil blowing is moderate on cultivated Lambert soil.

Nearly all of the acreage is used for dryfarmed wheat and barley. (Capability unit IIe-2, dryland; Silty range site, 15- to 19-inch precipitation zone)

Fattig Series

The Fattig series consists of well-drained, moderately sloping soils on uplands. These soils developed in place from material weathered from sandstone and shale that contains thin seams of lignite. The lignite gives the Fattig soils their characteristic black color. The native vegetation is grasses and sagebrush. Elevation is about 3,700 feet. The annual rainfall is 12 to 14 inches, the mean annual temperature is 47° F., and the frost-free season is 126 days.

In a typical profile, the surface layer is dark grayish-brown loamy fine sand and sandy clay loam 4 inches thick. The subsoil is very dark gray sandy clay loam 19 inches thick. The calcareous substratum is light brownish-gray light clay loam 10 inches thick. Depth to sandstone is 33 inches.

Permeability is moderately slow, and the available water capacity is 4 to 6 inches. Fertility is moderate, and the risk of soil blowing is high.

These soils are used for dryfarming and for range.

Typical profile of Fattig sandy clay loam, 4 to 7 percent slopes, about 1,075 feet west and 310 feet south of the E¼ corner of section 11, T. 7 N., R. 32 E.:

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) loamy fine sand, black (10YR 2/1) when moist; moderate, fine, crumb structure; soft when dry, friable when moist; noncalcareous; pH 8.2; abrupt boundary.

A12—2 to 4 inches, dark grayish-brown (10YR 4/2) sandy clay loam, black (10YR 2/1) when moist; weak, medium, platy structure that breaks to moderate, fine, crumb; soft when dry, friable when moist; noncalcareous; pH 7.4; abrupt boundary.

B21—4 to 12 inches, very dark gray (10YR 3/1) sandy clay loam, black (10YR 2/1) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, friable when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.4; gradual boundary.

B22t—12 to 16 inches, very dark gray (10YR 3/1) heavy sandy clay loam, black (10YR 2/1) when moist; weak, coarse, prismatic structure; very hard when dry, friable when moist, slightly sticky and slightly plastic when wet; thin, continuous clay films on all ped faces; noncalcareous; pH 7.4; clear, wavy boundary.

B3—16 to 23 inches, very dark grayish-brown (10YR 3/2) light sandy clay loam, black (10YR 2/1) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; thin patchy clay films on vertical faces of peds; noncalcareous; pH 7.4; clear, wavy boundary.

C1ca—23 to 33 inches, light brownish-gray (2.5Y 6/2) light clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; strongly calcareous; pH 7.4; clear, wavy boundary.

C2—33 inches, soft sandstone.

The A horizon ranges from loamy fine sand to sandy clay loam. Soil blowing has reduced the thickness of the surface layer in some places to less than 3 inches. The B2 horizon is 12 to 21 inches thick. The soil is free of lime to a depth of 20 inches. Depth to sandstone or sandy shale ranges from 20 to 40 inches.

Fattig sandy clay loam, 4 to 7 percent slopes (Fg).—This soil occurs on uplands in the northeastern part of the county. Slopes are dominantly 4 percent, and runoff is medium. Where coal seams lie at the surface, an occasional blowout occurs that is 5 to 8 feet deep and as much as 2 acres in size. Included in mapping are gently sloping Hydro soils that have darker than normal color.

Nearly all of this soil is used for range. Small grains are dryfarmed in areas where the soil is least sandy and droughty. (Capability unit IIIe-7 dryland; Sandy range site, 10- to 14-inch precipitation zone)

Fort Collins Series

The Fort Collins series consists of well-drained soils that are more than 60 inches deep. These soils formed in loamy alluvium on fans, terraces, and the sides of large stream valleys. The largest areas are on high terraces along the Yellowstone River Valley. The native vegetation is grasses, forbs, and sagebrush. Elevation ranges from 3,000 to 3,600 feet. The annual precipitation is 13 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 125 to 130 days. These soils are associated with Thurlow, Arvada, and McRae soils.

In a typical profile, the plow layer is grayish-brown clay loam 8 inches thick. It is a mixture of the original thin surface layer and the upper 4 inches of the subsoil. The subsoil is brown to light yellowish-brown clay loam 10 inches thick. The calcareous substratum is light-gray loam several feet thick.

Permeability is moderately slow, and the available water capacity is 10 to 12 inches. The organic-matter content is moderate, and the fertility is high.

These soils are used for dry and irrigated farming and for range. Small grains and hay are dryfarmed. Irrigated crops include sugar beets, dry beans, corn for silage, small grains, and hay.

Typical profile of a cultivated Fort Collins clay loam, 0 to 1 percent slopes, 60 feet south of road, 1,000 feet east of the S¼ corner of section 25, T. 1 N., R. 26 E.:

Ap1 0 to 4 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; cloddy; moderate, coarse, crumb structure; slightly hard when dry, firm when moist, slightly sticky and plastic when wet; noncalcareous; pH 7.4; clear, smooth boundary.

Ap2—4 to 8 inches, grayish-brown (10YR 5/2) heavy clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, angular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; noncalcareous; pH 7.4; abrupt, smooth boundary.

B21t—8 to 12 inches, brown (10YR 5/3) heavy clay loam, dark yellowish brown (10YR 4/4) when moist; strong, coarse, prismatic structure that breaks to moderate, coarse, blocky; hard when dry, firm when moist, very sticky and plastic when wet; thin, patchy clay films on ped faces; many medium pores and root channels; noncalcareous; pH 7.4; clear, wavy boundary.

B22t—12 to 15 inches, light olive-brown (2.5Y 5/4) light clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, prismatic structure; thin, patchy, clay films on ped faces; slightly hard when dry, friable when moist, sticky and plastic when wet; many medium pores and root channels; noncalcareous; pH 7.4; clear, wavy boundary.

B3—15 to 18 inches, light yellowish-brown (2.5Y 6/4) light clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.4; gradual, wavy boundary.

C1ca—18 to 25 inches, light-gray (2.5Y 7/2) heavy loam, light yellowish brown (2.5Y 6/3) when moist; weak, medium, blocky structure; slightly hard when dry, friable when moist, slightly sticky and nonplastic when wet; strongly calcareous; pH 8.4; gradual boundary.

C2—25 to 60 inches, light-gray (2.5Y 7/2) loam, light yellowish brown (2.5Y 6/3) when moist; massive; soft when dry, friable when moist, slightly sticky and nonplastic when wet; strongly calcareous; pH 8.4.

Fort Collins soils range from 10YR to 2.5Y in hue. Chroma is 2 or 3 in the A horizon and 3 or 4 in the B and C horizons. The C horizon has a value of 6 or 7 when dry and 5 or 6 when moist. The B horizon is clay loam or loam. Below a depth of 30 inches the C horizon may have stratified layers of sandy loam and silt loam. Depth to calcareous material is 8 to 20 inches. On river terraces the soil is underlain by loose, gravelly sand at a depth of more than 60 inches.

Fort Collins-Arvada clay loams, 0 to 1 percent slopes (Fl).—These soils occur in small, widely scattered areas on stream terraces and fans in the northern half of the county. The complex consists of about 75 percent Fort Collins clay loam and 25 percent Arvada clay loam. Each soil has a profile similar to the one described as typical for its series. In cultivated fields the grayish-brown surface of the Fort Collins soil contrasts sharply with the light-gray surface of the Arvada soil. In unplowed areas, the Fort Collins soil has dense, vigorous vegetation, whereas the Arvada soil has thin plant cover. The Arvada soil occupies pits that are 2 to 3 inches deep in some places. Water collects in these pits after heavy rains or when snow melts. Runoff is slow, and the risk of erosion is low.

These soils are used for dry and irrigated farming and for range. Wheat and barley are dryfarmed in a crop-fallow system. Irrigated crops are sugar beets, corn for silage, small grains, and hay. (Capability unit IIs–2, irrigated; IIIs 3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Fort Collins-Arvada clay loams, 1 to 4 percent slopes (Fo).—These soils occur in small, irregularly shaped areas on fans and terrace edges. About 75 percent of the complex is Fort Collins clay loam and 25 percent is Arvada clay loam. Each soil has a profile similar to the one described as typical for its series. In cultivated fields the light-gray Arvada soil is clearly distinguishable from the grayish-brown Fort Collins soil. On the edges of irrigated terraces, the Arvada soil has a few salt crystals in the surface layer. In uncultivated areas the Arvada soil occupies shallow pits that have a glazed gray surface and a thin grass cover. Slopes are dominantly 2 percent on the fans and 4 percent on the terrace edges. Surface runoff is medium, and the risk of water erosion is moderate.

These soils are used for dry and irrigated farming and for range. Small grains are dryfarmed in a crop-fallow system. Irrigated crops are sugar beets, corn for silage, small grains, and hay. (Capability unit IIe 1, irrigated; IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Fort Collins and Thurlow clay loams, 0 to 1 percent slopes (Fr).—These soils occur mostly on high fans and old terraces in the Yellowstone River Valley. A few small areas are on the margin of the dry lake basin north and west of Acton. Each soil has a profile similar to the one described as typical for its series. Surface runoff is slow. The risk of soil blowing and water erosion is slight.

Nearly all the acreage is used for dry and irrigated farming. Wheat and barley are dryfarmed in a crop-fallow system. Irrigated crops are sugar beets, dry beans, corn for silage, small grains, and hay. (Capability unit I–1, irrigated; IIIc–1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Fort Collins and Thurlow clay loams, 1 to 4 percent slopes (Ft).—These soils are on large fans at the mouth of tributary valleys that empty into the Yellowstone River Valley. Each soil has a profile similar to the one described as typical for its series. Slopes are dominantly 3 percent. Runoff is medium, and the risk of erosion is moderate.

These soils are used for dry and irrigated farming and for range. Wheat, barley, and hay are dryfarmed. Irrigated crops are sugar beets, dry beans, silage corn, small grains, and hay. (Capability unit IIe–1, irrigated; IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Gilt Edge Series

The Gilt Edge series consists of well drained, gently to moderately sloping soils on uplands. These soils formed in clayey materials weathered from shale and are 20 to 40 inches deep. The native vegetation is western wheatgrass, prairie junegrass, sagebrush, and plains reedgrass. Elevation ranges from 3,200 to 4,400 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 120 days. These soils are associated with Allentine soils.

In a typical profile, the surface layer is pale-brown to light-gray loam 6 inches thick. The subsoil is brown clay 14 inches thick. The substratum is light olive-brown, calcareous clay 17 inches thick. The upper part of the substratum contains a layer of crystalline gypsum, and the lower part contains many shale chips. Depth to shale and sandstone is 37 inches.

Permeability is slow, and the available water capacity is 5 to 6 inches. Fertility is moderate, and the risk of soil blowing is low.

These soils are used for wheat and barley dryfarmed in a crop-fallow system and for range.

Typical profile of Gilt Edge loam about 1,056 feet south and 510 feet east of the point where the trail enters section 15, T. 4 S., R. 25 E.:

A21—0 to 2 inches, pale-brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure that breaks to moderate, fine, granular; soft when dry, very friable when moist, nonsticky and nonplastic when wet; noncalcareous; pH 7.3; clear boundary.

A22—2 to 5 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, thin, platy structure that breaks to strong, fine, granular; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; thick silica coatings on upper part of plates; noncalcareous; pH 7.3; clear boundary.

A23—5 to 6 inches, light-gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) when moist; strong, thin, platy structure; soft when dry, very friable when moist, slightly sticky and nonplastic when wet; noncalcareous; pH 7.3; abrupt, wavy boundary.

B21t—6 to 9 inches, dark grayish-brown (10YR 4/2) heavy clay, dark brown (10YR 4/3) when moist; strong, fine, columnar structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; the tops of the columns and the upper one-half inch of the vertical faces are coated with silt that is white (10YR 8/2) when dry; all pores filled with clay; thick continuous clay films on all ped faces; noncalcareous; pH 7.4; gradual boundary.

B22t—9 to 14 inches, brown (10YR 5/3) heavy clay, dark brown (10YR 4/3) when moist; strong, fine and medium, prismatic structure that breaks to strong, fine and medium, blocky; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; pores filled with clay; thick continuous clay films on all ped faces; pH 9.0; gradual boundary.

B3—14 to 20 inches, light olive brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) when moist; strong, medium, prismatic structure that breaks to strong, fine and medium, blocky; extremely hard when dry, firm when moist, very sticky and very plastic when wet; weakly calcareous; a few lime nodules; pH 9.0; gradual, wavy boundary.

C1cs—20 to 30 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) when moist; moderate, coarse, prismatic structure that breaks to moderate, medium and coarse, blocky; extremely hard when dry, firm when moist, sticky and very plastic when wet; moderately calcareous; pH 8.5; common nests of gypsum; gradual, wavy boundary.

C2—30 to 37 inches, light yellowish-brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) when moist; massive; many shale chips; very strongly calcareous; pH 8.5; a few seams of gypsum in the upper part; gradual boundary.

C3—37 inches, thinly bedded hard shale and sandstone; lime crusts on under side of fragments.

Gilt Edge soils range from 10YR to 2.5Y in hue and from 2 to 4 in chroma. In value the A horizon is 6 or 7 when dry and 4 or 5 when moist. The A horizon is 3 to 7 inches thick. In cultivated fields the Ap horizon is clay loam. The B horizon is 10 to 18 inches thick and has columnar peds 4 to 7 inches thick. Lime begins at a depth of 10 to 18 inches. The C2 horizon is clay or clay loam. In value it is 5 or 6 when dry and 4 or 5 when it is moist. Gypsum is at a depth of 18 to 22 inches. Depth to shale and sandstone is 20 to 40 inches.

Gilt Edge-Allentine complex, 2 to 7 percent slopes (Ga).—This complex occurs in small irregularly shaped areas on uplands. Gilt Edge loam makes up 65 to 80 percent of the complex and Allentine clay, 20 to 36 percent. Each soil has a profile similar to the one described as typical for its series. In uncultivated areas the Gilt Edge soil has a thick grass cover. The Allentine soil normally lies in depressions 1 to 5 inches deep in which water collects after rains or when snow melts. In cultivated fields, the surface layer of the Gilt Edge soil is friable and that of the Allentine soil is hard and cloddy. Slopes are dominantly 3 percent. In drainageways relief is 15 feet and slopes are 7 percent. Runoff is slow to medium. Some runoff water is absorbed by the Gilt Edge soil.

Most of these soils are used for wheat and barley dryfarmed in a crop-fallow system. A few areas are used for range. (Capability unit IVe-5, dryland; Gilt Edge soil is in Silty range site, 10- to 14-inch precipitation zone; Allentine soil is in Clayey range site, 10- to 14-inch precipitation zone)

Glenberg Series

The Glenberg series consists of deep, well-drained, nearly level to gently sloping soils on flood plains, low terraces, and fans of large stream valleys. The soils formed in alluvium washed from sandstone and sandy shale in uplands. The native vegetation is grasses, forbs, and sagebrush. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 129 days.

In a typical profile, the cultivated surface layer is light brownish-gray fine sandy loam and light loam 11 inches thick. The substratum is stratified, calcareous, light brownish-gray loamy fine sand and pale-olive fine sandy loam. Depth to very gravelly loamy sand is 40 inches.

Permeability is moderately rapid, and the available water capacity is 7 to 8 inches. The fertility is moderate, and the organic-matter content is low. The risk of soil blowing is moderate.

Glenberg soils are used for dry and irrigated farming and for range.

Typical profile of cultivated Glenberg fine sandy loam, 1 to 4 percent slopes, about 1,450 feet east and 175 feet north of the center of section 35, T. 5 N., R. 33 E.:

Ap1—0 to 6 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; weakly calcareous; pH 7.5; abrupt, smooth boundary.

Ap2—6 to 11 inches, light brownish-gray (2.5Y 6/2) light loam, dark grayish brown (2.5Y 4/2) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; weakly calcareous; pH 7.8; clear, smooth boundary.

C1—11 to 21 inches, light brownish-gray (2.5Y 6/2) heavy loamy fine sand, light olive brown (2.5Y 5/3) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; weakly calcareous; pH 7.8; clear, wavy boundary.

C2—21 to 25 inches, light brownish-gray (2.5Y 6/2) loamy sand, dark grayish brown (2.5Y 4/2) when moist; single grain; loose when dry, friable when moist, nonsticky and nonplastic when wet; weakly calcareous; pH 8.4; clear, wavy boundary.

C3—25 to 40 inches, pale-olive (5Y 6/3) very fine sandy loam, olive (5Y 5/3) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; weakly calcareous; pH 8.4; clear, wavy boundary.

IIC4—40 to 60 inches, very gravelly loamy sand; single grain; loose when dry or moist, nonsticky and nonplastic when wet; pH 8.4.

Glenberg soils range from 10YR to 5Y in hue. The A and Ap horizons have color values of 5 or 6 when dry and 4 when moist; the chroma is 2 or 3. The C horizons have color values of 6 or 7 when dry and 5 or 6 when moist.

Glenberg fine sandy loam, 1 to 4 percent slopes (Gh).—This soil is mainly on fans in the valleys of intermittent streams where these valleys join the Yellowstone River Valley. Nearly all the soil is north of the Yellowstone River. The soil occupies areas 5 to 35 acres in size. The soil profile is typical for the series.

Slopes of 1 to 3 percent are most common, but some slopes of 4 percent occur on the upper sides of valleys near uplands. The risk of soil blowing on cultivated soil is moderate. The risk of water erosion on irrigated soil is moderate.

This soil is suited to dryfarmed small grains and hay and to irrigated sugar beets, dry beans, corn for silage, alfalfa, and pasture. Some areas are used for grazing cattle and for homesites. (Capability unit IIe–1, irrigated; IVe–2, dryland; Sandy range site, 10- to 14-inch precipitation zone)

Glenberg loam, 0 to 1 percent slopes (Gl).—This soil occurs on low terraces and flood plains of river valleys. Except for the loam surface layer 10 inches thick, the profile is similar to the one typical for the series. The surface is generally smooth, but in places channels 1 to 2 feet deep have been cut by floodwaters. Depth to gravelly sand is 48 inches.

This soil is used mostly for irrigated sugar beets, dry beans, alfalfa, and corn for silage. The soils on larger islands of the Yellowstone River are used for grazing cattle. (Capability unit I-1, irrigated; IIIc–1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Glenberg loam, gravelly substratum, 0 to 1 percent slopes (Go).—This soil occurs in small, scattered areas on low terraces and flood plains of river valleys. Except for the loam surface layer and a depth of 20 to 40 inches to gravelly sand, the profile is similar to the one typical for the series. The available water capacity is 5 to 7 inches, and the natural fertility is low to moderate. In some areas there is a seasonal water table in the underlying gravelly sand.

Nearly all the acreage is used for irrigated sugar beets, dry beans, alfalfa, and pasture. Small grains are dryfarmed in some areas. (Capability unit IIs–3, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Grail Series

The Grail series consists of deep, well-drained, nearly level to strongly sloping soils. These soils formed in mixed materials deposited on terraces, fans, and valley sides. The native vegetation is green needlegrass, western wheatgrass, prairie junegrass, and sagebrush. Elevation ranges from 3,000 to 4,100 feet. The annual precipitation is 13 to 15 inches, the mean annual temperature is 42 to 44° F., and the frost-free season is 115 to 120 days. Grail soils are associated with Maginnis, Amherst, and Absarokee soils on the uplands south of the Yellowstone River.

In a typical profile, the surface layer is grayish-brown heavy loam and light clay loam 5 inches thick. The subsoil is dark-brown heavy silty clay loam 9 inches thick. The substratum is grayish-brown clay loam and light olive-brown gravelly clay loam several feet thick. The gravel consists of semirounded hard shale and sandstone fragments or rounded pebbles washed from surrounding shale and gravel-capped uplands. The substratum is calcareous and contains light-gray threads and mottles of lime.

These soils are used for dry and irrigated farming and for range.

Typical profile of Grail clay loam, 2 to 4 percent slopes, in road cut, east side of road, 50 feet south of farm driveway, 1,320 feet west and 475 feet south of the E¼ corner of section 28, T. 1 S., R. 26 E.:

A11—0 to 2 inches, grayish-brown (10YR 5/2) heavy loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, crumb structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; noncalcareous; pH 7.8; clear, smooth boundary.

A12—2 to 5 inches, grayish-brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) when moist; strong, medium, platy structure; hard when dry, friable when moist, sticky and plastic when wet; noncalcareous; pH 7.8; clear, smooth boundary.

B21t—5 to 10 inches, dark-brown (10YR 4/3) heavy silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure; very hard when dry, firm when moist, very sticky and plastic when wet; thin continuous clay films on ped faces; noncalcareous; pH 7.8; gradual, wavy boundary.

B22t—10 to 14 inches, dark-brown (10YR 4/3) heavy clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure; hard when dry, firm when moist, sticky and plastic when wet; thin patchy clay films on vertical faces of peds; about 15 percent, by volume, is small, angular sandstone and shale chips; noncalcareous; pH 7.8; gradual, wavy boundary.

C1ca—14 to 25 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 8.4; common threads of lime; a few shale chips coated with lime; gradual, wavy boundary.

C2—25 to 60 inches, light olive-brown (2.5Y 5/3) gravelly clay loam, olive brown (2.5Y 3/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; 40 to 50 percent, by volume, is shale and sandstone gravel; calcareous; pH 8.4.

Grail soils range from 10YR to 5Y in hue. The A horizon is silty clay or clay loam that has a value of 4 or 5 when dry and 3 or 4 when moist. Chroma is 1 or 2. The B horizon, 8 to 16 inches thick, ranges from heavy clay loam to clay. Chroma is 2 or 3. In value, the C horizon is 5 or 6 when dry and 3 or 4 when moist. Depth to the Cca horizon is 10 to 16 inches. The C2 horizon is 0 to 50 percent gravel.

Grail clay loam, 2 to 4 percent slopes (Gr).—This soil occurs on small fans in large stream valleys south of the Yellowstone River Valley. Individual areas are 3 to 15 acres in size. The soil profile is similar to the one typical for the series except that the gravel content is higher in all layers. Spots having a very gravelly surface occur on the upper part of fans at the mouth of tributary drainageways in the valley of Pryor Creek. Included with this soil in mapping are spots of Hydro soils that have slopes of less than 2 percent.

Slopes are smooth, but many of the fans are dissected by a single gully that has steep sides. Runoff is medium, permeability is slow, and the risk of water erosion is moderate. The available water capacity is 7 to 8 inches.

This soil is used for dryfarmed and irrigated small grains and for range. (Capability unit IIe–1, irrigated; IIe–2, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Grail silty clay, 0 to 1 percent slopes (Gs).—This soil is on narrow stream terraces and small fans in the large valleys south of the Yellowstone River. The largest acreage is in the valley of Pryor Creek. The soil surface is broken by terrace levels and meanders. This soil has a profile similar to the one typical for the series except that it has no gravelly layers. It generally has a finer texture throughout than Grail clay loam, except along the perennial streams that flood frequently.

Slopes of 2 percent occur on fans, on breaks between two terrace levels, and on old channel scars that cross the terraces. Runoff and permeability are slow. The available water capacity is 8 to 10 inches. Areas adjacent to perennial streams are flooded occasionally. Areas where surface water is trapped in old channels or oxbows have a seasonal water table within 3 feet of the surface.

This soil is used for irrigated and dryfarmed small grains, alfalfa, and pasture, and for range. Most areas do not have a supply of irrigation water that lasts all season. (Capability unit IIs 1, irrigated; IIs 4, dryland; Clayey range site, 15- to 19-inch precipitation zone)

Grail soils, 2 to 15 percent slopes (Gt).—These soils occur in narrow valleys of intermittent streams. The largest acreage is in the valleys of Blue and Duck Creeks. The valleys are 300 to 800 feet wide, and receive runoff from Maginnis, Amherst, and Absarokee soils on uplands. Grail clay loam, silty clay loam, and silty clay occur in narrow bands on the valley sides and bottoms. Included in mapping these soils are patches of Haverson soils on valley bottoms, Kyle soils on valley sides, and Maginnis and Pierre soils below valley rims.

Slopes are dominantly 2 to 4 percent on the valley floor and 6 to 15 percent on the valley sides. Runoff is rapid on the strongly sloping valley sides, and the risk of erosion is high. The soils on the valley floor are subject to occasional flooding. The available water capacity ranges from 6 to 10 inches.

Soils on smooth valley bottoms are used for irrigated small grains and alfalfa. Small grains and hay are dryfarmed on the valley sides. Some areas are used for range. (Capability unit IIIe–4, dryland; Clayey and Overflow range sites, 15- to 19-inch precipitation zone)

Haverson Series

The Haverson series consists of well-drained, nearly level to moderately sloping, calcareous soils that are more than 60 inches deep. These soils formed in loamy alluvium on river flood plains, terraces, and fans. The native vegetation is grasses and sagebrush. Wild roses, cottonwoods, snowberry, buckbrush, and willow trees grow along the perennial streams. Elevation ranges from 2,900 to 3,700 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 130 days. These soils are associated with Lohmiller and Glenberg soils on the low terraces and flood plains of perennial streams.

In a typical profile, the surface layer is grayish-brown loam 5 inches thick. The substratum is light brownish-gray loam and light-gray silt loam several feet thick. Depth to loose sand and gravel is 58 inches.

Permeability is moderate, and the available water capacity is 8 to 10 inches. Fertility and the organic-matter content are moderate.

These soils are suited to dry and irrigated farming and to range. Small grains and hay are dryfarmed. Irrigated crops are sugar beets, dry beans, corn for silage, small grains, and hay.

Typical profile of cultivated Haverson loam, 0 to 1 percent slopes, on riverbank about 1,000 feet east of the center of section 6, T. 4 N., R. 32 E.:

Ap—0 to 5 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; weak, thick, platy structure; slightly hard when dry, friable when moist, nonsticky and slightly plastic when wet; moderately calcareous; pH 8.4; clear, wavy boundary.

C1—5 to 10 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) when moist; massive; soft when dry, friable when moist, nonsticky and slightly plastic when wet; moderately calcareous; pH 8.4; clear, wavy boundary.

C2—10 to 17 inches, light-gray (2.5Y 7/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; moderately calcareous; pH 8.4; clear, wavy boundary.

C3—17 to 58 inches, light brownish-gray (2.5Y 6/2) heavy loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, friable when moist, sticky and plastic when wet; common, yellowish-brown (10YR 5/6) mottles; moderately calcareous; pH 8.4; clear, wavy boundary.

IIC4—58 to 68 inches, loose sand and gravel; 80 percent, by volume, is pebbles and cobblestones 1 to 6 inches in diameter.

In value Haverson soils range from 5 to 7 when dry and from 4 to 6 when moist. The A horizon is loam, clay loam, or silty clay loam. In many places soils on river terraces are mottled with yellowish brown and light olive brown in the strata of fine silt and clay loam. They are underlain by sand and gravel at a depth of 36 to 60 inches. In some areas the soils are underlain by silty clay at a depth of 36 to 48 inches. The soils on the river flood plains have a water table below a depth of 60 inches.

Haverson loam, 0 to 1 percent slopes (Hc).—This soil is on bottom lands and low terraces along perennial streams. Some low bottom lands are flooded late in spring. In flooded areas the soil surface is cut by shallow channels. The surface layer is dark grayish brown, and a few salt crystals occur in the lower substratum. The soil profile is typical for the series. Runoff is slow, and water erosion is likely when the soil is flooded.

This soil is used for dry and irrigated farming and for range. Small grains and alfalfa are dryfarmed. Irrigated crops are sugar beets, dry beans, corn for silage, small grains, hay, and pasture. (Capability unit I–1, irrigated; IIIc–1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Haverson loam, clay substratum, 0 to 1 percent slopes (Hb).—This soil is mostly on fans and terraces in the Yellowstone River Valley west of Billings. The profile is similar to that typical for the series except that texture is

more uniform in the substratum and slowly permeable silty clay alluvium is at a depth of 36 to 48 inches. Included in mapping are spots of McRae soils that make up about 15 percent of any area mapped.

In some places overirrigation has produced an artificial water table that is above the silty clay substratum. The lateral movement of this water has caused seeped and saline spots to form in surrounding soils.

This soil is used for dry and irrigated farming and for range. Dryfarmed crops are wheat and barley. Irrigated crops are sugar beets, dry beans, silage corn, small grains, and hay. (Capability unit IIs–2, irrigated; IIIs–3, dryland; Silty range site, 10- to 14-inch precipitation zone)

Haverson clay loam, 0 to 1 percent slopes (Hc).—This soil is on low terraces of small stream valleys south of the Yellowstone River. The profile is similar to the one typical for the series except that the surface layer is grayish-brown clay loam 12 inches thick. Included in mapping are small spots of Haverson loam and Grail silty clay.

Runoff is slow. Much of the soil is subject to nondamaging floods in spring when snow melts rapidly. The banks of perennial streams are eroded during floods.

This soil is used mostly for range. Although irrigation water is scarce and the risk of flooding is high, some of this soil is used for dry and irrigated farming of small grains, alfalfa, and hay. (Capability unit I–1, irrigated; IIIc–1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Haverson silty clay loam, 0 to 1 percent slopes (Hd).—This soil is on terraces in stream valleys. Runoff is slow. The profile is similar to the one typical for the series except that the surface layer is silty clay loam. Also in the small stream valleys, the texture of the substratum is more uniform than in the typical profile and there are more dark grayish-brown loam strata at depths below 30 inches. Included in mapping are spots of Haverson clay loam where the valleys cross gravel terraces.

This soil is used for dry and irrigated farming and for range. Small grains and alfalfa are dryfarmed. The irrigated crops are sugar beets, dry beans, small grains, silage corn, and hay. (Capability unit I–1, irrigated; IIIc–1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Haverson silty clay loam, 1 to 3 percent slopes (He).—This soil is on fans and terraces in large stream valleys. Except for the silty clay loam surface layer, the profile is similar to that typical for the series. Slopes are dominantly 2 percent. Short slopes of 3 percent occur at the peak of large fans. Runoff is medium, and the risk of water erosion is moderate on irrigated soil.

This soil is used for dry and irrigated farming and for range. Wheat and barley are dryfarmed in a crop-fallow system. Irrigated crops are sugar beets, dry beans, small grains, silage corn, and hay. (Capability unit IIe-1, irrigated; IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Haverson-Hysham loams, 0 to 1 percent slopes (Hh).—These soils are on fans and terraces in the Yellowstone River Valley and along Crooked Creek north and west of Shepherd. Runoff is slow.

The complex is 65 percent Haverson loam and 35 percent Hysham loam. Each soil has a profile similar to the one described as typical for its series. Salt crystals are scattered throughout the Haverson soil. On low terraces adjacent to the Yellowstone River, the depth to gravelly sand is only 20 inches in some places. Cultivated Hysham soil is hard and cloddy and is lighter colored than the Haverson soil.

These soils are used for dry and irrigated farming and for range. All adapted crops can be grown on the Haverson soil. Small grains and hay are suited to the Hysham soil. (Capability unit IIs–2, irrigated; IIIs–3 dryland; Haverson soil is in Silty range site, 10- to 14-inch precipitation zone; Hysham soil is in Saline Subirrigated range site, 10- to 14-inch precipitation zone)

Haverson and Lohmiller soils, 0 to 4 percent slopes (Hl).—These soils occupy areas 150 to 300 feet wide and as much as one-half mile long on sides and bottoms of narrow stream valleys and drainageways on narrow terraces, and on meanders and oxbows along the channels of intermittent streams. The bottoms of the valleys and drainageways are well grassed and carry water only when snow melts or rain is heavy.

The two soils differ mainly in texture. The Haverson soil has a loam texture and the Lohmiller soil has a silty clay loam texture. The Lohmiller soil normally lies in partly filled stream meanders or in slack-water areas. In drainageways that cut through gravel terraces, both soils have thin layers of gravel below a depth of 24 inches.

Slopes are less than 75 feet long. They are 3 and 4 percent on the sides of drainageways and 0 to 2 percent on valley bottoms. Runoff is slow to medium.

These soils are used for range. (Capability unit VIw 2, dryland; Silty range site, 10- to 14-inch precipitation zone)

Haverson and Lohmiller soils, channeled, 0 to 35 percent slopes (Hm).—These soils occupy areas 100 to 500 feet wide and up to one-half mile long in the wide valleys of intermittent streams on uplands, and in drainageways that cross large fans and terraces in the Yellowstone River Valley. The soils are on the sides and bottom of valleys and drainageways and on the narrow terraces of the widest valleys. Soil texture varies within short distances in each mapped area.

The channels of the intermittent streams are 10 feet wide and 5 to 8 feet deep. They carry water only when snow melts or rains are heavy. Slopes are 0 to 2 percent on valley bottoms and 25 to 35 percent on the channel sides. Slopes are 15 to 75 feet long. Runoff is slow to rapid, and the risk of water erosion is low to high.

These soils are used for range. (Capability unit VIe 1, dryland; Silty range site, 10- to 14 inch precipitation zone)

Haverson loam, gravelly variant, 0 to 1 percent slopes (Hn).—This soil occupies 2- to 25-acre areas on low valley bottoms along the Yellowstone River. The profile is similar to that typical for the series, except that the subsoil is sandy and is more than 20 inches deep over loose, porous sand and gravel. In places irrigated soils have a seasonal water table within 36 inches of the surface. The available water capacity is 4 to 5 inches. The natural fertility is moderately low.

This soil is used for irrigated sugar beets, dry beans, small grains, corn for silage, and hay. (Capability unit IIIs–2, irrigated)

Heldt Series

The Heldt series consists of deep, well-drained, silty clay loam soils that formed in clayey alluvium deposited in valleys. The native vegetation is mainly western wheatgrass, green needlegrass, prairie junegrass, and sagebrush. Elevation is about 3,700 feet. The annual rainfall is 13 to 15 inches, the mean annual temperature is 47° F., and the frost-free season is 115 to 125 days. These soils are associated with Midway soils on uplands.

In a typical profile, the surface layer is grayish-brown light silty clay loam 3 inches thick. The subsoil is grayish-brown silty clay loam 4 inches thick. The substratum is stratified silty clay loam and silty clay several feet thick.

Permeability is slow, and the available water capacity is 8 to 10 inches. Runoff is medium, and the risk of water erosion is moderate. The natural fertility is moderate, and the organic-matter content is low.

These soils are used for dryfarmed small grains and hay and for range.

Typical profile of Heldt silty clay loam, 4 to 7 percent slopes, 1,570 feet east and 975 feet north of the SW. corner, section 12, T. 2 S., R. 28 E.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) light silty clay loam, dark grayish brown (2.5Y 4/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist, slightly sticky and plastic when wet; moderately calcareous; pH 7.8; clear, smooth boundary.

B2—3 to 7 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, prismatic structure that breaks to moderate, medium, granular; hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 8.4; a few fine threads of lime; clear, wavy boundary.

C1—7 to 17 inches, light brownish-gray (2.5Y 6/2) heavy silty clay loam, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure that breaks to moderate, fine, blocky; hard when dry, firm when moist, sticky and plastic when wet; strongly calcareous; a few lime mottles of light gray (2.5Y 7/2) when dry; pH 8.4; clear, wavy boundary.

C2ca—17 to 32 inches, light brownish-gray (2.5Y 6/2) heavy silty clay loam, grayish brown (2.5Y 5/2) when moist; moderate, medium, blocky structure; hard when dry, firm when moist, sticky and very plastic when wet; strongly calcareous; pH 8.4; a few white (2.5Y 8/2) lime mottles; these mottles increase in number with depth; clear, wavy boundary.

C3ca—32 to 47 inches, light-gray (2.5Y 7/2) light silty clay, grayish brown (2.5Y 5/2) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; strongly calcareous matrix; pH 8.4; common coarse lime mottles; gradual, wavy boundary.

C4—47 to 63 inches, light brownish-gray (2.5Y 6/2) heavy silty clay loam, grayish brown (2.5Y 5/2) when moist; massive; very hard when dry, very firm when moist, very sticky and very plastic when wet; strongly calcareous; pH 9.0.

In the A and B horizons, hue ranges from 2.5Y to 5Y; value is 5 or 6, and chroma is 2 or 3. The B horizon is 35 to 45 percent clay. The C horizon ranges from 2.5Y to 5Y in hue; value is 6 or 7, and chroma is 2 or 3. In the upper part, the C horizon is 35 to 45 percent clay, but below a depth of 24 inches, thin strata of silt loam or sandy loam may occur in the silty clay loam or silty clay.

Heldt silty clay loam, 4 to 7 percent slopes (Ho).—This soil occurs on fans and sides of small stream valleys throughout the county. Slopes are dominantly 6 percent. Included in mapping at the base of isolated hills and on uplands are areas where slopes are as much as 10 percent.

This soil is suited to dryfarmed winter wheat, barley, and hay. (Capability unit IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Hesper Series

The Hesper series consists of deep, nearly level to gently sloping, silty clay loam soils. These soils formed in alluvium deposited on terraces and fans. The native vegetation is mainly needle-and-thread, western wheatgrass, sagebrush, and prairie junegrass. Elevation is about 3,100 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 128 days. These soils are associated with Keiser and Toluca soils.

In a typical profile, the surface layer is grayish-brown silt loam 2 inches thick. The subsoil is brown silty clay loam or light clay, about 15 inches thick. The substratum is light olive-brown to pale-olive silty clay loam or clay loam and olive very fine sandy loam. The substratum is strongly calcareous and contains thin threads and soft rounded masses of lime. Depth to sand and gravel is 48 inches.

Permeability is moderately slow, and the available water capacity is 10 to 12 inches. The risk of soil blowing is low. The organic-matter content is moderate, and the fertility is high.

These soils are used for dry and irrigated farming and for range.

Typical profile of Hesper silty clay loam, 1 to 4 percent slopes, in the fence corner along the road in the NW. corner of SE¼NW¼, section 33, T. 2 N., R. 29 E.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; thin platy structure that breaks to weak, very fine, crumb; soft when dry, very friable when moist, nonsticky and nonplastic when wet; common bleached silt and very fine sand grains; noncalcareous; pH 7.2; abrupt boundary.

B21t—2 to 6 inches, brown (10YR 5/3) heavy silty clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to strong, very fine, subangular blocky; hard when dry, friable when moist, sticky and plastic when wet; moderately thick continuous clay films on ped faces; noncalcareous; pH 7.2; clear, smooth boundary.

B22t—6 to 13 inches, brown (10YR 5/3) light clay, dark brown (10YR 4/3) when moist; strong, medium and fine, prismatic structure that breaks to strong, fine and very fine, subangular blocky; very hard when dry, friable when moist, sticky and plastic when wet; thick continuous clay films on all ped faces; noncalcareous; pH 7.2; clear, smooth boundary.

B3—13 to 17 inches, light olive-brown (2.5Y 5/3) silty clay loam, olive brown (2.5Y 4/3) when moist; strong, medium and fine, prismatic structure that breaks to strong, fine, subangular blocky; hard when dry, friable when moist, sticky and plastic when wet; noncalcareous; pH 7.4; gradual, wavy boundary.

C1ca—17 to 21 inches, light olive-brown (2.5Y 5/3) light clay loam, olive brown (2.5Y 4/3) when moist; moderate.

medium and fine, subangular blocky structure; hard when dry, friable when moist; slightly sticky and slightly plastic when wet; strongly calcareous; common lime nodules; pH 8.4; gradual, wavy boundary.

C2ca—21 to 44 inches, pale-olive (5Y 6/3) light clay loam, olive gray (5Y 4/2) when moist; massive; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; strongly calcareous; many soft lime nodules; pH 8.4; gradual, wavy boundary.

C3—44 to 60 inches, olive (5Y 5/3) loam or very fine sandy loam, olive (5Y 4/3) when moist; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; moderately calcareous; a few seams of lime; pH 8.4.

Hue ranges from 10YR to 2.5Y in the A and B horizons and from 2.5Y to 5Y in the C horizon. In value the B horizon is 5 or 4 when dry and 4 or 3 when moist. Chroma in the B and C horizons is 2 or 3. Depth to the Cca horizon is 10 to 20 inches. In places pebbles occur on the surface and throughout all horizons.

Hesper silty clay loam, 0 to 1 percent slopes (Hp).—This soil occurs on high terraces and gravel-capped uplands along the Yellowstone River Valley. The profile of this soil has a thicker subsoil, a greater depth to lime, and a greater depth to gravel than the profile typical for the series. Runoff is slow, and the risk of water erosion is low. Included in mapping are ⅛- to ¼-acre spots of Shonkin soils on flats and in slight depressions.

This soil is used for dry and irrigated farming and for range. Irrigated crops are sugar beets, dry beans, small grains, hay, and corn for silage. Small grains and alfalfa are dryfarmed. (Capability unit I-1, irrigated; IIIc-1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Hesper silty clay loam, 1 to 4 percent slopes (Hr).—This soil occurs on high terraces, along the breaks between terraces, and on gravel-capped uplands that are crossed by shallow drainageways. The soil profile is typical for the series. Slopes are short and dominantly 2 percent. Surface runoff is medium, and the risk of water erosion is low to moderate. Much of the surface runoff enters the soil in swales and flats between low ridges and mounds. Included with this soil in mapping are spots of nearly level Bew and Shonkin soils. All mapped areas include as much as 10 percent Keiser soils.

This soil is used for dry and irrigated farming and for range. Irrigated crops are sugar beets, dry beans, small grains, corn for silage, and hay. Small grains are dryfarmed. (Capability unit IIe-1, irrigated; IIIe-5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Hilly Gravelly Land

Hilly gravelly land (Hs) occurs on stream valleys, on steep, dissected, gravelly terrace edges, and in drainageways south of the Yellowstone River and along Pryor Creek. Some mapped areas are ½ mile long and 300 acres in size. The native vegetation is skunkbush sumac, yucca, bluebunch wheatgrass, needle-and-thread, and annual weeds. The available water capacity and fertility are low. Included in mapping are Wanetta and Larim soils on narrow ridges and steep Bainville, Elso, and Midway soils below gravel deposits in deep drainageways.

In a typical profile, the surface soil is very gravelly loam, clay loam, or sandy loam 6 to 15 inches thick. It is dark brown to grayish brown in the upper 2 to 5 inches and pale brown to light yellowish brown in the lower part. Below a depth of 15 inches the soil is loose very gravelly sand that has a very low available water capacity. The gravel and cobblestones are 1 to 6 inches in diameter and are undercoated with lime.

Slopes are 15 to 35 percent and less than 200 feet long. Steep sandy soil occurs on the upper sides of drainageways and on terrace edges. Less steep loamy soil occurs on the lower sides of terrace edges and on the bottom of drainageways.

This land type is a source of sand and gravel for roads and building construction. It is also used for range. (Capability unit VIe-3, dryland; Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Hopley Series

The Hopley series consists of deep, moderately sloping, well-drained loamy soils on uplands. These soils formed in mixed shale and wind-deposited alluvium. The native vegetation is grasses and sagebrush. Elevation is 3,600 feet. Annual precipitation is 13 to 15 inches, the mean annual temperature is 46° F., and the frost-free season is 120 to 125 days.

In a typical profile, the surface layer is silt loam 2 inches thick. The subsoil is brown loam about 10 inches thick. The substratum is light-gray to pale-brown loam and contains a few light-gray spots of lime. Depth to shale is 47 inches.

Runoff is medium, permeability is moderate, and the available water capacity is 7 to 8 inches. The organic-matter content and fertility are moderate. The risk of soil blowing and water erosion is moderate.

Hopley soils are used for dryfarmed small grains and for range.

Typical profile of Hopley loam, 4 to 7 percent slopes, about 330 feet north and 175 feet west of the W¼ corner of section 1, T. 3 S., R. 24 E.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, medium, platy structure; soft when dry, very friable when moist; noncalcareous; pH 7.0; abrupt boundary.

B1—2 to 6 inches, dark grayish-brown (10YR 4/2) light loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure; slightly hard when dry, friable when moist; noncalcareous; pH 7.0; clear boundary.

B2—6 to 12 inches, brown (10YR 5/3) heavy loam, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; thin patchy clay films on vertical faces of peds; noncalcareous; pH 7.4; wavy boundary.

C1ca—12 to 16 inches, light-gray (10YR 7/2) loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; strongly calcareous; pH 8.4; clear boundary.

C2ca—16 to 32 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; a few lime nodules; pH 8.4; gradual boundary.

C3—32 to 47 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist; strongly calcareous; pH 8.4; gradual boundary.

R—47 inches, weathered shale and sandstone.

The Hopley soils range from 10YR to 2.5Y in hue. The B horizon is 5 to 11 inches thick. Depth to the Cca horizon is 7 to 13 inches. Depth to shale is 30 to 60 inches.

Hopley loam, 4 to 7 percent slopes (Ht).—This soil occurs on uplands along the south side of the Yellowstone River Valley east of Duck Creek. Slopes are dominantly 4 to 5 percent. Included in mapping are slopes of 2 to 3 percent on wide ridges and short slopes of 6 to 7 percent on the sides of the deep valleys and drainageways. Several inches of surface soil on long slopes and narrow ridgetops have been eroded by soil blowing and water erosion. Eroded areas in cultivated fields have a lighter surface color than uneroded soil.

The soil is used for dryfarmed wheat, barley, and hay. (Capability unit IIIe-4, dryland; Silty range site, 15- to 19-inch precipitation zone)

Hovert Series

The Hovert series consists of somewhat poorly drained, nearly level clayey soils in depressions and swales on shale uplands. The soils formed in clay alluvium. The native vegetation is western wheatgrass, green needlegrass, prairie junegrass, and sagebrush. Elevation ranges from 3,000 to 3,900 feet. Annual rainfall is 11 to 13 inches, the mean annual temperature is 47° F., and the frost-free season is 120 to 130 days. These soils are associated with Bainville, Elso, Razor, and Cushman soils.

In a typical profile, the surface layer is light-gray silt loam and light brownish-gray heavy loam about 3 inches thick. The subsoil is grayish-brown clay about 11 inches thick. The substratum is light yellowish-brown clay 46 inches thick. It is weakly calcareous and contains a few crystals of gypsum and other salts below a depth of 20 inches.

Hovert soils are used for range. They provide temporary waterholes for livestock and game animals when snow melts in spring.

Typical profile of Hovert clay, 0 to 1 percent slopes, 300 feet south of road, 600 feet south and 400 feet east of N¼ corner of section 18, T. 5 N., R. 32 E., 550 feet west of well:

A21—0 to 1 inch, light-gray (2.5Y 7/2) silt loam, dark grayish brown (2.5Y 4/2) when moist; vesicular; weak, thin, platy structure; soft when dry, very friable when moist; noncalcareous; pH 7.4; abrupt, smooth boundary.

A22—1 to 3 inches, light brownish-gray (2.5Y 6/2) heavy loam, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, platy structure; hard when dry, firm when moist, sticky and plastic when wet; a few, faint, yellowish-brown (10YR 5/4) mottles; noncalcareous; pH 7.4; clear, smooth boundary.

B21—3 to 6 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, coarse and medium, prismatic structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; noncalcareous; pH 7.4; gradual boundary.

B22—6 to 14 inches, grayish-brown (2.5Y 5/2) clay, olive brown (2.5Y 4/3) when moist; weak, coarse, prismatic structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; noncalcareous; pH 7.8; gradual boundary.

C1—14 to 26 inches, light yellowish-brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/4) when moist; weak, medium, blocky structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; weakly calcareous; pH 8.4; gradual boundary.

C2—26 to 37 inches, light yellowish-brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/4) when moist; massive; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; weakly calcareous; pH 8.4; gradual boundary.

C3—37 to 60 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; massive; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; weakly calcareous; pH 8.4.

The A horizon is silt loam or loam 1 to 4 inches thick. These soils range from 2.5Y to 5Y in hue. In chroma the B horizon ranges from 2 to 4 when dry and moist. Chroma of the C horizon is 3 or 4 when dry and moist.

Hovert clay, 0 to 1 percent slopes (Hu).—This soil is in undrained swales and shallow depressions north of the Yellowstone River Valley. The soil is flooded in spring when snow melts rapidly. Permeability is slow, and the available water capacity is 8 to 10 inches. The organic-matter content is low. The risk of soil blowing is low.

This soil is used for range. (Capability unit VIw-2, dryland; Overflow range site, 10- to 14-inch precipitation zone)

Hydro Series

The Hydro series consists of well-drained, nearly level to moderately sloping soils that formed in clay alluvium on fans or on uplands in material weathered from shale. The native vegetation is mainly western wheatgrass, needle-and-thread, prairie junegrass, and sagebrush. Elevation ranges from 3,300 to 3,800 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 130 days. These soils are associated with the Arvada, Allentine, Fattig, Wormser, and Lavina soils.

The surface layer is gray silt loam and grayish-brown light silty clay loam 5 inches thick. The subsoil is grayish-brown to gray clay and silty clay about 22 inches thick. The calcareous substratum is gray clay and clay loam that contains light-gray specks and fine threads of lime.

Permeability is slow, and the available water capacity is 8 to 10 inches. The organic-matter content and fertility are moderate. The risk of soil blowing is low.

These soils are used for dry and irrigated farming and for range.

Typical profile of Hydro clay loam, 0 to 2 percent slopes, about 870 feet south and 300 feet east of the NW. corner of section 7, T. 2 S., R. 29 E.:

A21—0 to 3 inches, gray (10YR 6/1) silt loam, dark gray (10YR 4/1) when moist; vesicular; massive; soft when dry, very friable when moist, nonsticky and nonplastic when wet; noncalcareous; pH 7.3; abrupt, smooth boundary.

A22—3 to 5 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, platy structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet; clean sand coatings on the tops of

plates; noncalcareous; pH 7.6; clear, wavy boundary.

B21t—5 to 10 inches, grayish-brown (2.5Y 5/2) clay, olive brown (2.5Y 4/3) when moist; strong, coarse, prismatic structure that breaks to strong, coarse, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; moderately thick, continuous clay films on ped faces; noncalcareous; pH 7.7; gradual, wavy boundary.

B22t—10 to 19 inches, light brownish-gray (2.5Y 6/2) clay, light olive brown (2.5Y 5/3) when moist; moderate, coarse, prismatic structure that breaks to strong, coarse, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; moderately thick, patchy clay films on ped faces; very strongly calcareous; pH 8.4; gradual, wavy boundary.

B3ca—19 to 27 inches, gray (5Y 5/1) silty clay, olive gray (5Y 4/2) when moist; weak, coarse, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; very strongly calcareous; common lime threads; pH 8.6; gradual boundary.

C1—27 to 41 inches, gray (5Y 5/1) clay, olive gray (5Y 4/2) when moist; weak, coarse, blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; very strongly calcareous; common threads of lime; pH 8.6; gradual boundary.

C2—41 to 60 inches, gray (5Y 6/1) clay loam, dark gray (5Y 4/1) when moist; massive; hard when dry, firm when moist, sticky and very plastic when wet; strongly calcareous.

Hydro soils range from 10YR to 5Y in hue. Chroma is 1 or 3 and is lowest in the A horizon. Where the soils are underlain by shale and sandstone, seams of lignite occur in all horizons. The B horizon is 38 to 55 percent clay. The B horizon, when dry, ranges from 3 to 6 in value. When moist, this horizon ranges from 2 to 5 in value. Depth to calcareous material is 12 to 30 inches. Soils on fans have a few pebbles that washed on the surface from the high terraces bordering the stream valleys. In places a few gypsum crystals occur below a depth of 20 inches. Depth to bedrock in soils on uplands is 20 to 40 inches.

Hydro-Allentine complex, 2 to 7 percent slopes (Hv).—These soils occur in small, irregularly shaped areas on shale and sandstone uplands. The complex is about 65 percent Hydro clay loam and 35 percent Allentine clay. The subsoil of the Hydro soil contains less clay than is typical for the series. The Allentine soil has a profile similar to the one typical for its series except that a gypsum layer is within 6 inches of the surface. Both soils are underlain by shale and sandstone at a depth of 20 to 40 inches. In cultivated areas the Hydro soil has a good grass cover and is 3 to 6 inches above the Allentine soil, which occupies nearly barren pits.

Slopes are dominantly 2 percent. Slopes of 4 to 7 percent occur along deep drainageways and the sides of narrow, high ridges. Runoff is slow on the Hydro soil and medium on the Allentine soil. Much of the surface runoff from the Allentine soil is absorbed by the Hydro soil.

These soils are used mostly for range. In a few areas wheat and barley are dryfarmed. (Capability unit IVe–5, dryland; Hydro soil is in Silty range site, 10- to 14-inch precipitation zone; Allentine soil is in Clayey range site, 10- to 14-inch precipitation zone)

Hydro-Arvada clay loams, 0 to 2 percent slopes (Hw).—These soils are on fans and valley sides on the south side of the lake basin west of Acton, and in the larger valleys of the Pryor Creek drainage system. The areas are 5 to 150 acres in size. Hydro clay makes up 65 to 80 percent of the complex, and Arvada soils, 20 to 35 percent. The profile of the Hydro soil is typical for the series. The profile of the Arvada soil is similar to the one described as typical for the series except that the gypsum layer is less distinct, the lime is more deeply leached, and the subsoil is more permeable. In uncultivated areas the Arvada soil occupies nearly barren depressions 2 to 6 inches deep between hummocks of well-grassed Hydro soil. Cultivated Arvada soil has cloddy tilth.

Slopes are 1 to 2 percent on the fans. Runoff water collects on the Arvada soil when rains are heavy and snow melts. Included are slopes of 3 to 4 percent on valley sides where the risk of water erosion is moderate.

These soils are suited to range. Small areas are used for dry and irrigated farming. Shallow-rooted grasses and small grains are suited to irrigated soils. (Capability unit IIs–2, irrigated; IIIs–3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Hysham Series

The Hysham series consist of well drained and moderately well drained, calcareous soils on terraces and fans. These soils formed in mixed loamy and silty alluvium and are more than 60 inches deep. The native vegetation is western wheatgrass, greasewood, sagebrush, and prairie junegrass. Elevation ranges from 2,900 to 3,800 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 122 to 130 days. These soils are associated with Haverson, Lohmiller, and Laurel soils.

In a typical profile, the surface layer is grayish-brown and olive-gray loam 7 inches thick. The substratum is stratified olive-gray to light-gray sandy loam, silt loam, and loamy sand. It is very strongly alkaline.

Permeability is slow, and the available water capacity is 7 to 9 inches. The natural fertility is moderate, and the organic-matter content is low.

These soils are used for dry and irrigated farming and for range.

Typical profile of Hysham loam, 0 to 2 percent slopes, about one-eighth mile north of the SE. corner of section 19, T. 2 S., R. 24 E.:

A11—0 to 3 inches, grayish-brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) when moist; the upper one-half inch of this horizon is vesicular and massive; the rest is weak, medium, granular; very hard when dry, friable when moist, sticky and plastic when wet; moderately calcareous; pH 9.4; gradual boundary.

A12—3 to 7 inches, olive-gray (5Y 5/2) loam, dark olive gray (5Y 3/2) when moist; weak, medium, granular structure; very hard when dry, friable when moist, nonsticky and nonplastic when wet; moderately calcareous; pH 9.4; gradual boundary.

C1—7 to 24 inches, olive-gray (5Y 5/2) sandy loam, olive gray (5Y 4/2) when moist; massive; very hard when dry, friable when moist, nonsticky and nonplastic when wet; moderately calcareous; pH 9.4; clear boundary.

C2—24 to 29 inches, gray (5Y 5/1) silt loam, olive gray (5Y 4/2) when moist; massive; very hard when dry, friable when moist; nonsticky and nonplastic when wet; moderately calcareous; pH 9.4; common, fine, distinct mottles; gradual boundary.

C3—29 to 33 inches, gray (5Y 5/1) silt loam, dark gray (5Y 4/1) when moist; massive; very hard when dry, friable when moist, nonsticky and nonplastic when wet; moderately calcareous; pH 9.3; common nests of gypsum and other salts; common, medium, distinct mottles; clear boundary.

C4—33 to 50 inches, light-gray (5Y 6/1) loamy sand, olive gray (5Y 4/2) when moist; single grain; loose when moist; moderately calcareous; pH 8.4; gradual boundary.

C5—50 to 55 inches, gray (5Y 5/1) stratified sandy loam and silt loam, dark gray (5Y 4/1) when moist; massive; moderately calcareous; pH 8.2; a few nests of gypsum and other salts; common, medium, distinct mottles; gradual boundary.

IIC—55 inches, sand and gravel.

These soils range from 2.5Y to 5Y in hue and from 1 to 3 in chroma. All horizons may have a value of 5 when dry and of 3 when moist. In cultivated fields the Ap horizon is very fine sandy loam to silty clay loam. This horizon is cloddy when dry, and the clods slake and form a hard, glazed crust when wet. Where undisturbed, these soils may have a thin, gray A horizon underlain by a C horizon that has prismatic structure in the upper part. Salt crystals are scattered throughout the C horizon below a depth of 12 inches. Soils on river terraces are underlain by gravelly sand and have a water table within 72 inches of the surface.

Hysham-Laurel loams, 0 to 2 percent slopes (Hx).—These soils occupy small areas on low terraces and flood plains in the irrigated parts of the Yellowstone River Valley and in the valleys of large, intermittent streams north of the valley. Hysham loam makes up 65 percent of the complex and Laurel loam, 35 percent. Each soil has a profile similar to the one described as typical for its series. The surface of cultivated Laurel soil is granular and salt flecked, and the surface of cultivated Hysham soil is glazed. In uncultivated areas the Laurel soils are 3 to 10 inches higher than the Hysham soil. Slopes are less than 1 percent on terraces and flood plains and 2 percent along the short breaks between terraces.

These soils are used mainly for range, though some of the acreage has been cultivated. (Capability unit IVw–1, irrigated; VIw–1, dryland; Saline Subirrigated range site, 10- to 14-inch precipitation zone)

Hysham-Laurel silty clay loams, 0 to 2 percent slopes (Hy).—These soils occur on fans and terraces. About 60 percent of the unit is Hysham silty clay loam, and 40 percent is Laurel silty clay loam. The profile of each soil is similar to the one described as typical for its series except that the surface layer is silty clay loam. The cultivated Hysham soil has a glazed, slaked surface crust, and the Laurel soil has a granular, salt-flecked surface.

Slopes are dominantly 2 percent. Included in mapping are short slopes of 4 to 5 percent along the sharp breaks between terraces. A water table occurs below a depth of 60 inches in both soils.

These soils are used for irrigated farming and for range. They are well suited to salt-tolerant grasses. (Capability unit IVw–1, irrigated; VIw–1, dryland; Saline Subirrigated range site, 10- to 14-inch precipitation zone)

Hysham and Haverson soils, 0 to 4 percent slopes (Hz).—These soils occur in narrow drainageways and in the valleys of small intermittent streams. The soils occupy the short sides of drainageways, the nearly level valley bottoms that are cut in many places by a deep, meandering channel, and the narrow terraces along the channels. The typical mapped area is long and more than 350 feet wide in a few places. The Hysham soil occupies the largest acreage in some mapped areas and the Haverson soil in others. The profile of each soil is similar to the one described as typical for its series except that Haverson soil has salt crystals in the substratum. In uncultivated areas Hysham loam has a thin cover of grass and greasewood plants that grow in the nearly barren spots.

Slopes are less than 1 percent on the drainageway bottoms. Included with these soils in mapping are areas where slopes are as much as 15 percent. These slopes are 30 to 60 feet long and occur on the sides of drainageways. The soils are occasionally flooded by runoff water from the surrounding uplands.

These soils are used mostly for grazing. (Hysham soil is in capability unit VIs–1, dryland; Saline Subirrigated range site, 10- to 14-inch precipitation zone; Haverson soil is in capability unit IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Judith Series

The Judith series consists of well-drained soils that formed in mixed alluvium washed from the Pryor Mountains. These soils occupy narrow bands along the edges of deep drainageways or on the steep slopes between high gravel terraces in the southern part of the county. The native vegetation is mostly bunchgrass, forbs, and shrubs. Elevation ranges from 3,400 to 4,000 feet. The annual precipitation is 14 to 17 inches, the mean annual temperature is 42 to 44° F., and the frost-free season is 115 to 125 days. In this county Judith soils are mapped only with Danvers soils in a complex.

In a typical profile, the plow layer is dark grayish-brown loam 6 inches thick. It is 15 percent gravel, by volume. The upper part of the substratum is dark grayish-brown and grayish-brown clay loam and very pale-brown gravelly clay loam. It contains some lime and is 15 to 20 percent gravel, by volume. The lower part of the substratum is limy, pale-brown very gravelly clay loam.

Permeability is moderately slow, and the available water capacity is 5 to 7 inches. Fertility is high. In some areas, cobblestones on the surface interfere with plowing.

Judith soils are used for dryfarming and for range.

Typical profile of a Judith loam, 90 feet east and 275 feet north of the SW. corner of section 20, T. 4 S., R. 27 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, very fine, crumb structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; 15 percent gravel, by volume; weakly calcareous; pH 8.4; abrupt, smooth boundary.

C1—6 to 8 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) when moist; weak, medium, prismatic structure that breaks to weak, medium, blocky; hard when dry, firm when moist, sticky and plastic when wet; 15 percent gravel, by volume; weakly calcareous in spots; pH 8.4; clear, wavy boundary.

C2—8 to 10 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; 15 percent

gravel, by volume; moderately calcareous; pH 8.4; gradual, wavy boundary.

C3ca—10 to 17 inches, very pale brown (10YR 7/3) gravelly clay loam, yellowish brown (10YR 5/4) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; 20 percent gravel, by volume; violently effervescent; pH 8.4; gradual, wavy boundary.

C4—17 to 50 inches, pale-brown (10YR 6/3) very gravelly clay loam, brown (10YR 5/3) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; 40 percent lime-coated gravel, by volume; violently effervescent.

The calcium carbonate equivalent of the C3ca horizon is more than 25 percent. Gravel content increases with depth and is 35 to 55 percent, by volume, at a depth of 36 inches.

Keiser Series

The Keiser series consists of deep, well-drained, level to sloping soils on broad stream terraces and uplands along the valleys of major rivers. These soils formed in mixed silty alluvium deposited by water and wind. The native vegetation is needle-and-thread, western wheatgrass, blue grama, winterfat, and sagebrush. Elevation ranges from 3,000 to 3,600 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days. Keiser soils are associated in mapping with Clapper, Hesper, Shorey, and Toluca soils.

In a typical profile, the surface layer is grayish-brown silt loam 2 inches thick. The subsoil is brownish silty clay loam and silty clay about 8 inches thick. The calcareous substratum is light-gray silty clay loam to silt loam that contains specks of lime.

Permeability is slow, and the available water capacity is 10 to 12 inches. The fertility and organic-matter content are moderate. The risk of soil blowing is low.

These soils are used for dry and irrigated farming and for range.

Typical profile of Keiser silty clay loam, 0 to 1 percent slopes, 400 feet east of W1/4 corner of section 5, T. 1 N., R. 28 E.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure that breaks to weak, fine, crumb; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many bleached sand grains; noncalcareous; pH 7.3; clear, smooth boundary.

B1—2 to 3 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium, platy structure; slightly hard when dry, firm when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.3; clear, wavy boundary.

B21t—3 to 7 inches, brown (10YR 5/3) silty clay, dark brown (10YR 3/3) when moist; strong, medium, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, firm when moist, sticky and very plastic when wet; moderately thick, continuous clay films on ped faces; noncalcareous; pH 7.3; gradual, wavy boundary.

B22ca—7 to 10 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure; hard when dry, firm when moist, sticky and plastic when wet; thin, patchy clay films on ped faces; very strongly calcareous; pH 8.4; gradual, wavy boundary.

C1ca—10 to 23 inches, light-gray (2.5Y 7/2) light silty clay loam, light yellowish brown (2.5Y 6/3) when moist; very weak, coarse, prismatic structure; hard when dry, firm when moist, sticky and plastic when wet; very strongly calcareous; pH 8.4; common lime nodules; gradual boundary.

C2—23 to 60 inches, light-gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) when moist; massive; soft when dry, friable when moist, nonsticky and slightly plastic when wet; very strongly calcareous; pH 9.0.

Keiser soils range from 10YR to 2.5Y in hue and from 2 to 3 in chroma. In cultivated fields the Ap horizon is silty clay loam that is mixed with much of the subsoil. The B horizon is 4 to 10 inches thick; clay content is 35 to 45 percent. The B horizon has a value of 5 or 6 when dry and of 4 or 5 when moist. Depth to the Cca horizon is 8 to 12 inches. In some areas gravel occurs below a depth of 40 inches.

Keiser silty clay loam, 0 to 1 percent slopes (Kc).—This soil occurs on the high terraces and fans of the Yellowstone River Valley and on bordering gravel-capped uplands. The areas are 5 to 250 acres in size. Surface runoff is very slow, and drainageways are very indistinct. The soil profile is typical for the series, and all layers have the maximum thickness. Included with this soil in mapping are Bew, Shonkin, and Hesper soils in level areas, shallow swales, or depressions where water collects. These soils make up 10 percent of any area mapped.

This soil is used for dry and irrigated farming and for range. Irrigated crops are sugar beets, dry beans, corn for silage, small grains, and hay. Small grains are dryfarmed. (Capability unit I–1, irrigated; IIIc–1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Keiser silty clay loam, 1 to 4 percent slopes (Ke).—This soil occurs mostly on the undulating terraces along the Yellowstone River near Custer. The soil generally occupies eroded parts of terraces where drainageways are distinct. It is more sloping and has more uneven slopes than Keiser silty clay loam, 0 to 1 percent slopes. Included with this soil in mapping are small areas of Lambert and Wanetta soils.

Slopes are dominantly 2 percent. Runoff is slow, and the risk of water erosion is moderate. On the crests of sharp ridges and on the stronger slopes, the combined thickness of the surface layer and subsoil is less than 9 inches. In cultivated areas, light-gray patches of the very limy substratum occur on the surface. On high terraces and benches, a few pebbles are scattered throughout the soil.

This soil is used mostly for dry and irrigated farming. A few areas are used for range. (Capability unit IIe–1, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Keiser silty clay loam, 4 to 7 percent slopes (Kg).—This soil is on terrace edges, on breaks between terraces, and on silt-covered uplands. The profile of the soil is similar to the one described as typical for the series except that the thickness of the surface layer and the subsoil and the depth to lime are minimum. The surface layer of cultivated soil is calcareous and is light gray where the substratum has been plowed to the surface. On river terraces, the depth to sand and gravel is 40 to 48 inches. Pebbles occur on the stronger slopes. Slopes are dominantly 4 and 5 percent. Slopes of 6 and 7 percent occur on silt-capped upland ridges that are underlain

by shale. Runoff is medium. The fertility is lower than that of the less steep Keiser soils. Included with this soil in mapping are some irrigated areas that are moderately eroded.

About half this soil is used for dry and irrigated farming, and about half is in range. Irrigated crops are small grains, hay, and pasture. Small grains also are dryfarmed. (Capability unit IIIe-2, irrigated; IIIe 5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Keiser and Hesper silty clay loams, 0 to 1 percent slopes (Kn).—These soils are on terraces in the Yellowstone River Valley. The surface layer of Keiser soil is calcareous where plowed deeper than 8 inches.

Nearly all of the acreage of these soils is used for irrigated sugar beets, dry beans, corn for silage, small grains, and hay. (Capability unit I-1, irrigated; IIIc-1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Kyle Series

The Kyle series consists of well-drained, nearly level to gently sloping, fine-textured, calcareous soils that are 40 to 60 inches deep. These soils formed in clay alluvium on fans, foot slopes, and terraces of stream valleys and in clay shale on uplands. The native vegetation is mainly western wheatgrass, green needlegrass, and sagebrush. Elevation ranges from 2,700 to 3,900 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost free season is about 121 days. Kyle soils are associated with Pierre and Vananda soils.

In a typical profile, the surface layer is grayish-brown silty clay 9 inches thick. It is directly underlain by a grayish-brown and light brownish-gray clay substratum. On shale uplands, the substratum contains thin threads and small crystals of gypsum.

Kyle soils are used for dry and irrigated farming and for range.

Typical profile of cultivated Kyle silty clay, 0 to 1 percent slopes, 280 feet south and 40 feet east of W¼ corner of section 20, T. 2 N., R. 27 E.:

Ap—0 to 9 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; moderate, fine, granular structure in the upper part to moderate, fine and very fine, blocky in the lower part; extremely hard when dry, very firm when moist, sticky and very plastic when wet; calcareous; pH 7.7; abrupt boundary.

C1—9 to 30 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, fine and very fine, blocky in upper part; few medium-sized pressure surfaces in lower part; extremely hard when dry, very firm when moist, sticky and very plastic when wet; calcareous; pH 7.8; gradual boundary.

C2—30 to 60 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; massive; a few lenses of silty clay loam less than 3 inches thick; extremely hard when dry, very firm when moist, very sticky and plastic when wet; calcareous; pH 8.2.

Kyle soils range from 2.5Y to 5Y in hue and from silty clay to clay in texture. The A horizon has a value of 5 or 6 when dry and is 4 when moist. In the C horizon, value is 5 or 6 when dry and is 4 or 5 when moist. The C horizon has a few rust-colored mottles where runoff is slow. In some places gravelly loam or sand occurs below a depth of 48 inches, or clay shale occurs below a depth of 40 inches. The pH ranges from 7.5 to 8.5.

Kyle silty clay, 0 to 1 percent slopes (Kl).—This soil occurs on smooth terraces and alluvial fans in the Yellowstone River Valley and in the dry lake basin south of Broadview. On the river terraces this soil is underlain by very gravelly loam or sand below a depth of 48 inches. Included with this soil in mapping are small areas of Vananda silty clay.

Runoff and permeability are slow. Dry soil blows readily. The available water capacity is 8 to 10 inches in a 5-foot depth. The organic-matter content is medium, and the fertility is moderate. Plant roots penetrate this soil slowly.

This soil is used for dry and irrigated farming and for range. Irrigated crops are sugar beets, corn for silage, and hay. Small grains are dryfarmed. (Capability unit IIIs-1, irrigated; IIIs-3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Kyle silty clay, 1 to 4 percent slopes (Km).—This soil occurs on uplands and fans between Acton and Shepherd and in the southeastern part of the Crow Indian Reservation. The areas are 5 to 60 acres in size. This soil is underlain by clay shale, and the substratum contains thin threads and small crystals of gypsum. The soil on fans is more than 60 inches deep in places. Runoff is medium, and the risk of water erosion is slight. Dry soil blows readily. Included with this soil in mapping are areas of steep Pierre clay soils on narrow ridges or along the sides of drainageways on uplands. These areas are ½ acre to 2 acres in size.

This soil is used mostly for range. Some areas are used for dryfarmed hay and pasture. (Capability unit IIIe-1, irrigated; IIIe-3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Kyle silty clay, 4 to 7 percent slopes (Kn).—This soil occurs on fans, foot slopes, and uplands east of Acton and in the southeastern quarter of the county. The areas are 5 to 75 acres in size. This soil contains less clay in all horizons than Kyle silty clay, 0 to 1 percent slopes. In uplands the soils are 40 to 60 inches deep over clay shale. Some slopes of 3 percent occur on the larger fans. Runoff is medium to rapid, and the risk of water erosion is moderate. The dry granular surface blows easily. Included in mapping are areas of Pierre clay on narrow ridgetops and the sides of deep narrow drainageways on uplands. These areas are ½ acre to 3 acres in size.

This soil is used for dryfarming and for range. (Capability unit IVe-5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Lambert Series

The Lambert series consists of deep, gently sloping to moderately steep, well-drained, calcareous soils on terraces, fans, and uplands. These soils formed in silty alluvium deposited by wind and water. The native vegetation is grasses, sagebrush, and broom snakeweed. Elevation ranges from 2,900 to 3,800 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 44 to 46° F., and the frost-free season is 115 to

128 days. Lambert soils are associated with Haverson, McRae, Keiser, and Farland soils.

In a typical profile, the plow layer is light brownish-gray heavy silt loam about 9 inches thick. It is a mixture of the thin grayish-brown original surface layer and the upper 6 to 7 inches of the substratum. The substratum is light-gray to light brownish-gray silt loam several feet thick.

Permeability is moderately slow, and the available water capacity is 10 to 12 inches. The organic-matter content and fertility are moderate.

These soils are used for dry and irrigated farming and for range. Wheat and barley are dryfarmed. Irrigated crops are sugar beets, dry beans, corn for silage, small grains, and hay.

Typical profile of Lambert silt loam, 1 to 4 percent slopes, 1,575 feet north and 100 feet west of the NE. corner of section 20, T. 2 S., R. 25 E.:

- Ap—0 to 9 inches, light brownish-gray (2.5Y 6/2) heavy silt loam, grayish brown (2.5Y 4/2) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; strongly calcareous; pH 8.4; abrupt, smooth boundary.
- C1—9 to 14 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and slightly plastic when wet; very strongly calcareous; pH 8.4; gradual, wavy boundary.
- C2—14 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; soft when dry, friable when moist, nonsticky and nonplastic when wet; very strongly calcareous; pH 8.4.

In value the C horizon is 6 or 7 when dry and 5 or 6 when moist. In areas not cultivated, the A11 horizon is grayish-brown silt loam or loam 1 to 4 inches thick, but the A12 horizon is 2 to 3 inches thick.

Lambert silt loam, 1 to 4 percent slopes (La).—This soil occurs on stream terraces in the Yellowstone River Valley and on bordering gravel-capped uplands. The soil profile is typical for the series. Slopes are dominantly 1 percent and 300 to 375 feet long. Runoff is slow. Because the plow layer contains lime, the cultivated soil is subject to moderate soil blowing. Included in mapping are spots of nearly level Keiser soils on terraces.

This soil is used for dry and irrigated farming and for range. Wheat and barley are dryfarmed in a crop-fallow system. Irrigated crops are sugar beets, dry beans, silage corn, small grains, and hay. (Capability unit IIe-1, irrigated; IIIe-5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Lambert silt loam, 4 to 7 percent slopes (Lb).—This soil is on the high terraces, fans, and benches along the Yellowstone and Bighorn Rivers and Pryor Creek. The drainageways are shallow and broad. Slopes are mainly 4 percent, and runoff is medium. Some irrigated soils on the steeper slopes have been moderately eroded. The risk of water erosion is moderate on the cultivated soils.

This soil is used for dry and irrigated farming and for range. Wheat and barley are dryfarmed. Irrigated crops are small grains and hay. Because the soil washes easily, the water runs for irrigated row crops should not be more than 100 feet long. (Capability unit IIIe-2, irrigated; IIIe-5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Lambert silt loam, 7 to 15 percent slopes (Lc).—This soil is on terraces, bench edges, and loess-covered uplands that are crossed by deep drainageways. Most of the soil is in the drainageways of Duck Creek and Pryor Creek. Surface pebbles are scattered on the terrace edges. Slopes are short, uneven, and mainly 10 to 12 percent. The local relief ranges from 15 to 30 feet. Runoff is rapid, and the risk of soil blowing and water erosion on cultivated soil is moderate to high. In some cultivated fields, this soil has been damaged by water erosion.

This soil is used for wheat and barley dryfarmed in a crop-fallow system and for range. (Capability unit IVe-3, dryland; Silty range site, 10- to 14-inch precipitation zone)

Lambert soils, 7 to 35 percent slopes (Ld).—This soil is on eroded edges between terraces and fans in the Yellowstone River Valley and on the sides of intermittent streams that empty into the Yellowstone River. The soil profile is similar to the one described as typical for the series. Slopes are dominantly 7 to 10 percent on the terraces and 15 to 25 percent elsewhere. Slopes of 30 to 35 percent occur where deep drainageways intersect the main stream channel. Runoff is medium to rapid, and the risk of water erosion is high. The entire surface layer has been eroded from the steepest soils. The risk of soil blowing is moderate.

This soil is used for range. Some areas in the valley have been smoothed and are irrigated for hay and pasture. (Capability unit VIe-1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Larim Series

The Larim series consists of noncalcareous, well-drained to somewhat excessively drained, gently sloping to moderately steep soils on terraces of large stream valleys. These soils formed in gravelly alluvium and are 10 to 20 inches deep over loose sand and gravel. The native vegetation is grasses and sagebrush. Elevation ranges from 3,000 to 3,400 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost free season is about 128 days. These soils are associated with the Wanetta soils.

In a typical profile, the surface layer is grayish-brown loam 3 inches thick and contains 10 percent pebbles, by volume. The subsoil is brown gravelly and sandy clay loam about 13 inches thick. The substratum is sand and gravel. A light gray lime layer lies at the top of the underlying gravel, and the pebbles are undercoated with lime.

Permeability is moderate, and the available water capacity is 3 to 4 inches. The organic-matter content is moderate, and the fertility is low. The root zone is shallow.

These soils are used for range and for irrigated small grains, hay, and pasture.

Typical profile of Larim loam, 0 to 4 percent slopes, 110 feet west of E¼ corner of section 6, T. 2 S., R. 25 E.:

- A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) when moist; weak, thin, platy structure; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; 10 percent, by volume, is pebbles; noncalcareous; pH 7.3; abrupt, smooth boundary.

B1—3 to 5 inches, grayish-brown (10YR 5/2) light clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; 15 percent, by volume, is pebbles; noncalcareous; pH 7.3; clear, smooth boundary.

B2t—5 to 13 inches, brown (10YR 5/3) gravelly clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, blocky; moderately thick, patchy clay films on ped faces; hard when dry, firm when moist, sticky and plastic when wet; noncalcareous; pH 7.3; 25 percent, by volume, is pebbles; gradual, wavy boundary.

B3—13 to 16 inches, light yellowish-brown (2.5Y 6/3) gravelly sandy clay loam, olive brown (2.5Y 3/3) when moist; very weak, coarse, blocky structure; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; 40 percent, by volume, is pebbles; noncalcareous; pH 7.3; gradual boundary.

C—16 to 60 inches, loose sand and gravel; 80 percent, by volume, is pebbles 1 to 6 inches in diameter; pebbles are undercoated with lime; pockets of loamy sand in the gravel.

Larim soils range from 10YR to 2.5Y in hue. In the B and C horizons chroma is 3 or 4. The A horizon is loam or gravelly loam. The amount of pebbles and cobblestones on the surface ranges from 0 to 45 percent, by volume. In cultivated areas, the Ap horizon is light clay loam. The B horizon is 6 to 18 inches thick and is 10 to 55 percent pebbles. The C horizon is 40 to 90 percent pebbles and cobblestones that are 1 to 6 inches in diameter.

Larim loam, 0 to 4 percent slopes (Le).—This soil is on fans and terraces in the Yellowstone River Valley and on bordering gravel-capped uplands. The landscape is uneven and marked by shallow water channels. The soil profile is typical for the series. Slopes are mainly 0 to 1 percent. Slopes in drainageways are 4 percent. Runoff is slow, and the risk of water erosion and soil blowing is low. Included with this soil in mapping are spots of Wanetta and Larim gravelly loam soils that make up 15 to 20 percent of the mapped areas. Also included are irrigated soils that have seeps and a cover of wetland sedges and grasses.

This soil is used for irrigated small grains, hay, and pasture and for range. (Capability unit IVe–1, irrigated; VIe–3, dryland; Shallow to Gravel range site, 10- to 14 inch precipitation zone)

Larim gravelly loam, 0 to 4 percent slopes (Lg).—This soil occurs on terraces in the Yellowstone River Valley. The profile is similar to the one typical for the series except that the surface layer is gravelly loam, and in places the soil is underlain by gravel free sand. Slopes are mainly 1 percent. Some slopes of 4 percent occur where shallow drainageways cross the terraces. Drainageways are broad and less than 36 inches deep. Runoff is slow. Included with this soil in mapping are spots of Larim loam.

This gravelly loam is used for irrigated small grains, hay, and pasture and for range. (Capability unit IVe–1, irrigated; VIe–3, dryland; Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Larim gravelly loam, 4 to 7 percent slopes (Lh).—This soil occurs on terraces in the Yellowstone River Valley and on bordering gravel-capped uplands. The surface has been eroded by water into a pattern of narrow, sloping ridges separated by shallow drainageways. In places the soil occupies narrow bands between terraces. The profile is similar to the one described as typical for the series except that the surface layer is gravelly loam. Tillage increases the amount of gravel in the surface layer to more than 30 percent, by volume.

Slopes are short. They are 4 and 5 percent on ridges and in shallow drainageways and 6 and 7 percent along deep drainageways near terrace edges. Runoff is medium, and the risk of erosion is moderate.

This soil is used for irrigated small grains, hay, and pasture and for range. (Capability unit IVe–1, irrigated; VIe–3, dryland; Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Larim gravelly loam, 15 to 35 percent slopes (Ll).—This soil occurs in the valleys of the Yellowstone River and larger tributary streams. It lies in long narrow bands on breaks and edges between terraces. The soil layers are less thick, the subsoil contains less clay, and the amount of gravel at all depths is greater than in the profile described as typical for the series. About 35 to 55 percent of the surface is covered with gravel. Included with this soil in mapping are spots of Clapper soils where the soils formed in gravelly loam. Also included are spots of Hilly gravelly land.

Slopes are smooth except where major drainageways cross the terrace edges. Two-thirds of the slopes are more than 25 percent. Runoff is rapid, and some areas receive water from soils that lie above them. The risk of erosion is high.

This soil is used only for range. Seepage from irrigated terraces has increased the amount of forage that grows in some drainageways. (Capability unit VIe–3, dryland; Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Laurel Series

The Laurel series consists of somewhat poorly drained, calcareous soils that are more than 60 inches deep. These soils formed in loamy alluvium that contains a high amount of salt. The native vegetation consists mostly of inland saltgrass, kochia, western wheatgrass, alkali sacaton, and greasewood. Elevation ranges from 3,000 to 3,400 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days. These soils are mapped only in complexes with Hysham soils.

In a typical profile the surface layer is grayish-brown loam 10 inches thick. The substratum is stratified light brownish-gray to light olive-gray loam, sandy loam, silty clay loam, and silty clay several feet thick.

Permeability is moderate to moderately slow, and the available water capacity is 8 to 10 inches. The water table is at a depth of 60 to 72 inches most of the time, but seasonally it rises to within 36 inches of the surface. The organic-matter content is low, and the fertility is moderate. These soils are suited to range.

Typical profile of a Laurel loam, 1,285 feet north and 175 feet east of the center of the NW¼ of section 26, T. 3 N., R. 29 E.:

Ap—0 to 10 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; weak gran-

ular structure beneath a fragile crust; hard when dry, friable when moist, sticky and slightly plastic when wet; moderately calcareous; pH 8.8; many seams and nests of gypsum and other salts; gradual, wavy boundary.

C1sa—10 to 24 inches, light brownish-gray (2.5Y 6/2) light silty clay loam, light olive brown (2.5Y 5/3) when moist; massive; very hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 9.0; many seams and nests of gypsum and other salts; gradual boundary.

C2sa—24 to 33 inches, olive-gray (5Y 5/2) silty clay, olive gray (5Y 4/2) when moist; massive; very hard when dry firm when moist; very sticky and very plastic when wet; moderately calcareous; pH 9.4; many seams of gypsum and other salts; clear, wavy boundary.

IIC3—33 to 52 inches, light olive-gray (5Y 6/2) heavy sandy loam, olive (5Y 5/3) when moist; massive; hard when dry, friable when moist, nonsticky and slightly plastic when wet; weakly calcareous; pH 9.6; gradual, wavy boundary.

IIC4—52 to 60 inches, light olive-gray (5Y 6/2) sandy loam, olive (5Y 5/3) when moist; hard when dry, friable when moist, nonsticky and slightly plastic when wet; weakly calcareous; pH 9.6; 30 percent, by volume, is pebbles.

Laurel soils range from 2.5Y to 5Y in hue; chroma is 2 or 3. The pH ranges from 8.4 to 9.6. The horizon containing the greatest amount of salts occurs within 15 inches of the surface. This horizon is white when dry and is very porous. In some places many light yellowish-brown mottles occur below a depth of 15 inches. The C horizon consists of strata that are 3 to 6 inches thick and range from sandy loam to silty clay. Gravelly sand underlies these soils on river terraces below a depth of 60 inches.

Lavina Series

The Lavina series consists of shallow, well-drained, gently sloping soils on uplands in the western part of the county. These soils formed in material weathered from weakly calcareous hard shale and sandstone. The native vegetation is mainly bluebunch wheatgrass, yucca, needle-and-thread, and western wheatgrass. Elevation ranges from 3,300 to 3,700 feet. Annual precipitation is 12 to 14 inches, the mean annual temperature is 45° F., and the frost-free season is about 118 days. Lavina soils are associated with Wormser and Travessilla soils, and formed in the same kinds of rock material.

In a typical profile, the surface layer is grayish-brown sandy loam and brown loam 6 inches thick. The subsoil is dark grayish-brown clay loam and dark-brown light clay about 13 inches thick. Indurated sandstone lies at a depth of 19 inches.

Permeability is moderate, and the available water capacity is 2 to 3 inches. Fertility is low. Plant roots penetrate to the bedrock.

Lavina soils are used mainly for range, but a few small areas are dryfarmed.

Typical profile of Lavina loam, 2 to 4 percent slopes, 100 feet south and 20 feet east of electric transmission line pole 215/3 near center of section 9, T. 1 N., R. 25 E.:

A11—0 to 2 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 4/3) when moist; weak, medium, crumb structure; soft when dry, friable when moist; noncalcareous; pH 7.3; gradual, smooth boundary.

A12—2 to 6 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak, medium, crumb structure; slightly hard when dry, friable when moist; noncalcareous; pH 7.3; gradual boundary.

B21t—6 to 8 inches, dark grayish brown (10YR 4/2) clay loam, dark yellowish brown (10YR 4/4) when moist; weak, coarse, blocky; slightly hard when dry, firm when moist, slightly sticky and slightly plastic when wet; moderately thick, continuous clay films on ped faces; distinct clay flow through the interior of peds; noncalcareous; pH 7.3; clear boundary.

B22t—8 to 19 inches, dark-brown (10YR 4/3) light clay, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure that breaks to strong, medium and fine, blocky; very hard when dry, very firm when moist, sticky and plastic when wet; moderately thick continuous clay films on all ped faces; noncalcareous; pH 7.4; clear, wavy boundary.

R—19 inches, indurated sandstone.

The A horizon is sandy loam or loam 3 to 6 inches thick. The B horizon is clay loam to light clay 5 to 14 inches thick. Depth to unweathered shale and sandstone is 8 to 20 inches. The soil is free of lime, but the fragments of shale and sandstone are undercoated with lime. Partly weathered fragments of shale and sandstone occur where these soils are less than 15 inches thick.

Lavina loam, 2 to 4 percent slopes (Lm).—This soil occupies smooth, broad ridges and shallow swales between deep valleys that drain sandstone and shale uplands. The profile is typical for the series. Included in mapping are Travessilla soils along valley rims and Wanetta soils in level areas where the depth to bedrock is more than 20 inches.

Slopes are dominantly 2 percent. Slopes of 3 and 4 percent occur where drainageways cut through the valley rims. Runoff is slow. Nearly all precipitation enters the soil in the flats and shallow swales between low knolls and flat-topped ridges. A few of the deeper depressions are ponded when rain is heavy or snow melts.

This soil is used for grazing beef cattle. Rangeland can be reseeded. (Capability unit VIe-3, dryland; Shallow Limy range site, 10- to 14-inch precipitation zone)

Lismas Series

The Lismas series consists of shallow, well-drained, moderately steep, calcareous clay soils on uplands. These soils formed in material weathered from platy shale. The native vegetation is western wheatgrass, blue grama, sagebrush, and scattered greasewood. Elevation ranges from 3,000 to 4,500 feet. Annual precipitation is 12 to 15 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days. These soils are associated with Pierre soils and Kyle soils.

In a typical profile, the surface layer is light olive-gray clay 2 inches thick. The upper part of the substratum is light olive-gray clay 8 inches thick. In the lower part of the substratum are a few threads of lime and crystals of gypsum. The substratum contains partly weathered shale chips below a depth of 8 inches. Depth to shale is 10 inches.

Permeability is slow, and the available water capacity is 2 to 3 inches. Fertility is low. The risk of soil blowing is moderate to high on dry, bare soil.

These soils are used only for range.

Typical profile of Lismas clay, 15 to 35 percent slopes,

on a ditchbank on the east side of the road, 475 feet south of the NW. corner of section 8, T. 2 N., R. 25 E.:

A1—0 to 2 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) when moist; strong, very fine, granular structure; slightly hard when dry, firm when moist, very sticky and very plastic when wet; calcareous; pH 8.4; clear boundary.

C1—2 to 5 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) when moist; moderate, medium, platy structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; weakly calcareous; pH 8.4; gradual, wavy boundary.

C2—5 to 10 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) when moist; strong, coarse, platy structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; many partly weathered shale chips; moderately calcareous; pH 8.4; a few lime nodules and coarse nests of gypsum; diffuse boundary.

C3—10 to 18 inches, weathered platy shale chips; moderately calcareous in spots; common lime nodules and crystals of gypsum; iron stains on shale chips; diffuse boundary.

C4—18 inches, partly weathered and unweathered shale; calcareous in spots; many gypsum crystals.

Depth to shale ranges from 10 to 20 inches. The amount of clay in all layers ranges from 45 to 65 percent, by volume.

Lismas clay, 15 to 35 percent slopes (Ln).—This soil is on deeply eroded shale uplands. Sharp, closely spaced ridges separate narrow, steep-sided coulees or drainageways. The steeper soils have only a sparse cover of grass and sagebrush and some greasewood. Shale crops out on the steepest slopes, on ridge points, and on the sides of eroded drainageways.

In the Pryor Creek drainage system, this soil occurs on the sides of drainageways and stream valleys that cut through upland terraces. The terraces have a mantle of gravelly loam alluvium. The drainageways have cut through this thick gravelly alluvium into the underlying clay shale. The ridges and drainageways slope steeply from the gravelly terrace edges to the floor of the main valleys. Scattered patches of gravel occur on the widest ridges. Pebbles and cobblestones are on the surface in some areas.

Included with this soil in mapping are small areas of Hilly gravelly land. Also included are areas of Pierre soils that have slopes of less than 15 percent and of other soils that have slopes of as much as 40 percent. Slopes are short. Runoff is rapid, and the risk of erosion is high. Moderate rill and gully erosion occurs on the steep south-facing slopes and in overgrazed areas.

This soil is used only for range. (Capability unit VIIs-1, dryland, Shale range site, 10- to 14-inch precipitation zone)

Lohmiller Series

The Lohmiller series consists of well-drained, nearly level to moderately sloping, calcareous soils on terraces, fans, and valley sides. These soils formed in clayey, stream-deposited alluvium. The native vegetation is green needlegrass, western wheatgrass, prairie junegrass, and sagebrush. Elevation ranges from 2,900 to 3,800 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 130 days. These soils are associated with Kyle, Hysham, and Haverson soils in the stream valleys and Elso and Midway soils on the shale uplands.

In a typical profile, the plow layer is grayish-brown silty clay 9 inches thick. It is a mixture of the original silty clay loam surface layer, which was 2 inches thick, and the upper 6 to 7 inches of substratum. The substratum is stratified calcareous clay, clay loam, loam, and fine sandy loam. The coarser textured layers occur in the deeper substrata.

Permeability is moderately slow, and the available water capacity is 8 to 10 inches. The organic-matter content and fertility are moderate. The risk of soil blowing is moderate.

These soils are used for dry and irrigated farming. Wheat, barley, and hay are dryfarmed. Irrigated crops are sugar beets, corn for silage, small grains, and hay.

Typical profile of cultivated Lohmiller silty clay, 0 to 1 percent slopes, 1,050 feet east and 125 feet north of the N¼ corner of section 24, T. 1 S., R. 25 E.:

Ap1—0 to 2 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; weak, medium, platy structure that breaks to strong, fine, granular; slightly hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 8.4; clear, smooth boundary.

Ap2—2 to 9 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) when moist; strong, fine, angular blocky structure; hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 8.4; clear, wavy boundary.

C1—9 to 17 inches, light olive gray (5Y 6/2) clay, olive (5Y 4/3) when moist; weak, very coarse, blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; strongly calcareous; pH 8.4; gradual, wavy boundary.

C2—17 to 26 inches, light olive-gray (5Y 6/2) clay, olive (5Y 4/3) when moist; moderate, medium, angular blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; strongly calcareous; pH 8.4; gradual, wavy boundary.

C3—26 to 37 inches, pale-olive (5Y 6/3) loam, olive (5Y 5/3) when moist; massive; soft when dry, friable when moist, nonsticky and slightly plastic when wet; moderately calcareous; pH 8.4; gradual, wavy boundary.

C4—37 to 42 inches, pale-olive (5Y 6/3) heavy clay loam, olive (5Y 5/3) when moist; massive; slightly hard when dry, firm when moist, slightly sticky and plastic when wet; moderately calcareous; pH 8.4; gradual, wavy boundary.

C5—42 to 60 inches, pale-yellow (5Y 7/3) fine sandy loam, pale olive (5Y 6/3) when moist; massive; soft when dry, friable when moist, nonsticky and slightly plastic when wet; moderately calcareous; pH 8.4.

Lohmiller soils range from 2.5Y to 5Y in hue. In value the soils range from 5 to 7 when dry and from 4 to 6 when moist. The A horizon ranges from silty clay loam to silty clay. The widest range of texture occurs in nearly level soils on stream terraces. Soils on gravel-capped uplands have pebbles on the surface. Very gravelly sand may occur at a depth of 20 to 40 inches.

Lohmiller silty clay loam, 3 to 7 percent slopes (Lo).—This soil is on fans, terraces, and valley sides above flood plains. Except for the silty clay loam surface layer, the profile is similar to that described as typical for the series. Slopes are mainly 3 to 4 percent on fans and terraces and 5 to 7 percent on valley sides. Short slopes of 8 to 12 percent occur just below the valley rims. This soil has the longest slopes of all the Lohmiller soils. Runoff is medium, and the risk of water erosion is moderate.

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Some cultivated areas on the larger fans and valley sides have gullies and rills caused by runoff from surrounding uplands.

This soil is used for dry and irrigated farming and for range. Wheat and barley are dryfarmed. Irrigated crops are small grains and hay. (Capability unit IIIe–2, irrigated; IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Lohmiller silty clay, 0 to 1 percent slopes (Lr).—This soil is on bottom lands and terraces. The profile is similar to that described as typical for the series, but in places the substratum is gravelly loam below a depth of 36 inches. The substratum is clay to a depth of 48 inches in old channel scars and in small depressions on terraces. Runoff is slow. The risk of soil blowing is moderate in cultivated areas.

This soil is used for dry and irrigated farming and for range. Wheat, barley, and hay are dryfarmed. Irrigated crops are sugar beets, corn for silage, small grains, and hay. (Capability unit IIs–1, irrigated; IIIs–3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Lohmiller soils, seeped, 0 to 2 percent slopes (Ls).—This soil occurs in small areas on the irrigated terraces of the Yellowstone River Valley. The seepage is caused by overirrigation and improper drainage. The water table is at a depth of 48 to 60 inches during part of the growing season. A few areas are naturally seeped by nearby streams. The profile is similar to the one described as typical for the series except that the substratum contains rust-colored mottles, and crystals of gypsum and other salts occur throughout the soil. Some very saline soils have a white salt crust on the surface late in winter and in spring. Slopes are less than 1 percent on the terraces and 2 percent on the fans that lie below the irrigation canals. Runoff is slow, and the risk of water erosion is slight.

Salt-tolerant grasses are grown for pasture on this soil. If the soil is reclaimed by leaching the salts, all adapted irrigated crops except dry beans can be grown. (Capability unit IIw–1, irrigated)

Lohmiller-Elso complex, 4 to 15 percent slopes (Lt).—This complex occurs in large areas of wide valleys of intermittent streams in the northeastern part of the county. It is 45 percent Lohmiller silty clay loam, 35 percent Elso clay loam, and 20 percent Shale outcrop, eroded terrace edges, and deep drainageways. The drainageways are severely eroded. Runoff is medium to rapid, and the risk of erosion is high.

The Lohmiller soil is deep and occupies smooth fans, valley sides, and small terraces. It has slopes ranging from 4 to 10 percent and is deeply cut by dry stream channels and their short tributary gullies. Elso soil is shallow and occupies scattered knolls and low ridges that rise 3 to 15 feet above the surrounding Lohmiller soil. Slopes are dominantly 8 to 15 percent on the Elso soils. Shale crops out on ridgetops and on stream bottoms where the underlying shale has been eroded. Included in mapping are areas of McRae loam on fans and valley sides. These included areas may make up 10 percent of the mapped areas.

This complex is used for range. Small areas of Lohmiller soil are dryfarmed. (Capability unit IVe–4, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Lohmiller-Hysham silty clay loams, 0 to 1 percent slopes (Lu).—These soils are on level bottom lands and terraces, mostly in the Yellowstone River Valley. Each soil makes up about half of any mapped area. The profile of each soil is similar to the one described as typical for its series, except that the surface layer is dark grayish-brown silty clay loam. The substratum of the Lohmiller soil contains salts. In cultivated areas the Hysham soil occurs in patches 1/4 to 1 acre in size. It is hard and cloddy when plowed. The clods slake to a hard, glazed crust when wet.

These soils are used for dryfarmed and irrigated small grains, hay, and pasture. (Capability unit IIs–2, irrigated; IIIs–3, dryland)

Lohmiller silty clay, gravelly variant, 0 to 1 percent slopes (Lv).—This soil is on low terraces in the Yellowstone River Valley. The soil is occasionally flooded late in spring. The profile is typical for the series except that the surface layer is silty clay loam to silty clay, and the soil is only 20 to 40 inches deep over loose, very gravelly sand. The surface layer is dark grayish brown where the soil is in slight depressions marked by old channels. In places a water table is within 36 inches of the surface during the irrigation season. Here the substratum contains rust-colored mottles and a few salt crystals. Short slopes of 2 percent occur in old channels that lie 1 to 2 feet below the terraces. Permeability is slow, and the available water capacity is 4 to 5 inches. Runoff is slow.

This soil is used for dry and irrigated farming and for range. Wheat and barley are dryfarmed. Irrigated crops are sugar beets, silage corn, small grains, and hay. (Capability unit IIs–1, irrigated; IIIs–3, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Maginnis Series

The Maginnis series consists of well-drained to somewhat excessively drained, very shallow, strongly sloping to very steep soils. These soils formed in materials weathered from hard, noncalcareous platy shale and fine-grained sandstone. They are extensive along the deep valleys in the southern part of the county. The native vegetation is bluebunch wheatgrass, prairie junegrass, annual weeds, and skunkbush sumac. Elevation ranges from 3,500 to 4,800 feet. The annual precipitation is 14 to 16 inches, and the frost-free season is 110 to 120 days. These soils are associated with Absarokee and Amherst soils on uplands and Grail soils in valleys.

In a typical profile, the surface layer, about 2 inches thick, is grayish-brown channery loam that contains shale and sandstone fragments. The subsoil is brown, very channery heavy clay loam about 8 inches thick. The top and bottom of the shale and sandstone fragments are coated with clay. The substratum is shattered shale and sandstone at a depth of 10 inches.

Permeability is moderately slow, and the available water capacity is 1 to 2 inches. The organic-matter content is moderate, and fertility is low. Roots penetrate the upper bedrock through mats between sandstone and shale plates.

These soils are used for dryfarmed small grains and for range.

Typical profile of Maginnis channery clay loam, 7 to 15 percent slopes, on bank along trail, 75 feet east of fence, 1,150 feet south and 1,635 feet west of NE. corner of section 3, T. 3 S., R. 25 E.:

A—0 to 2 inches, grayish-brown (10YR 5/2) channery loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, crumb structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; 30 to 35 percent, by volume, is shale and sandstone fragments ½ inch to 4 inches in diameter; noncalcareous; pH 6.5; clear, wavy boundary.

B2—2 to 10 inches, brown (10YR 5/3) very channery heavy clay loam, dark yellowish brown (10YR 4/4) when moist; 60 to 70 percent shale fragments, by volume; thin continuous clay films on upper and lower faces of the fragments; noncalcareous; pH 6.5; clear, wavy boundary.

C1—10 to 13 inches, weathering sandy shale that has small seams of bentonite.

C2—13 to 27 inches, bentonite.

C3—27 to 30 inches, hard sandy shale.

Fragments of shale and sandstone, ½ inch to 4 inches in diameter, make up 5 to 40 percent of the A horizon and 50 to 80 percent of the B horizon. Depth to bedrock is 4 to 15 inches. These soils are noncalcareous throughout.

Maginnis channery clay loam, 7 to 15 percent slopes (Ma).—This soil occurs on narrow ridges and the sides of deep drainageways. The areas are bands less than 50 acres in size that lie along valley rims above steeper Maginnis soils. The soil profile is typical for the series. Slopes are dominantly 12 percent. Runoff is medium to rapid, and the risk of erosion is moderate to high.

This soil is used for dryfarmed small grains and for range. The cultivated areas normally are surrounded by areas of Amherst soils. (Capability unit VIIs–1, dryland; Shallow Nonlimy range site, 15- to 19-inch precipitation zone)

Maginnis channery clay loam, 15 to 35 percent slopes (Mc).—This soil is in the southern part of the county. It occurs along the sides and rims of deep valleys and drainageways and on shale uplands. The profile is similar to the one described as typical for the series. Included in mapping are areas of shale outcrops and thin soils underlain by shale. Also included are overgrazed areas that are moderately eroded. Runoff is rapid and the risk of erosion is high.

This soil is used only for range. (Capability unit VIIs–1, dryland; Shallow Nonlimy range site, 15- to 19 inch precipitation zone)

Maginnis-Rock outcrop complex, 35 to 60 percent slopes (Mg).—This complex occurs on deeply dissected shale uplands south of the Yellowstone River Valley. It occurs on the steep sides of the valleys of large streams and short valleys of their tributaries. The areas range from 75 to 150 acres in size.

The complex is 40 percent Maginnis channery clay loam and 60 percent Rock outcrop. The profile of the Maginnis soil is similar to the one described as typical for its series except that the surface layer is more than 50 percent shale fragments. Slopes are 35 to 50 percent on the Maginnis soil and 45 to 60 percent on the Rock outcrop. Shale fragments have accumulated below the vertical rock outcrops.

This complex is used for range where slope and vegetation permit. (Capability unit VIIs–1, dryland; Shallow Nonlimy range site, 15- to 19-inch precipitation zone)

McKenzie Series

The McKenzie series consists of moderately well drained, nearly level, clay soils in dry lake basins, in undrained potholes, and on terraces. These soils formed in clay alluvium. The native vegetation is western wheatgrass, green needlegrass, prairie junegrass, and foxtail barley. Elevation ranges from 2,900 to 3,300 feet. The annual rainfall is 12 to 14 inches, the mean annual temperature is 47° F., and the frost-free season is 120 to 126 days. These soils are associated with Vananda, Kyle, and Heldt soils.

In a typical profile, the surface layer is gray silty clay and clay 5 inches thick. The substratum is gray to pale-olive clay several feet thick, A few, distinct, rust-colored mottles occur below a depth of 30 inches.

Permeability is very slow and surface ponding occurs when snow melts or rain is heavy. Much of the ponded water evaporates before it can enter the soil. Dry, bare soil is highly susceptible to soil blowing. The available water capacity is 8 to 10 inches, and the fertility is moderate.

McKenzie soils are used for range.

Typical profile of McKenzie clay, 0 to 1 percent slopes, one-eighth mile north of the SE. corner of section 1, T. 3 N., R. 23 E.:

A—0 to 1 inch, gray (5Y 5/1) light silty clay, dark gray (5Y 4/1) when moist; moderate, very fine, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 8.4; clear boundary.

AC—1 to 5 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) when moist; moderate, medium to very fine, blocky structure; extremely hard when dry, extremely firm when moist, very sticky and extremely plastic when wet; moderately calcareous; pH 8.4; gradual boundary.

C1—5 to 16 inches, gray (5Y 6/1) clay, dark gray (5Y 4/1) when moist; under moderate pressure breaks to sharply angular fragments; extremely hard when dry, extremely firm when moist, very sticky and extremely plastic when wet; moderately calcareous; pH 8.4; gradual boundary.

C2—16 to 38 inches, gray (5Y 5/1) clay, very dark gray (5Y 3/1) when moist; under moderate pressure breaks to sharply angular fragments; extremely hard when dry, extremely firm when moist, very sticky and extremely plastic when wet; moderately calcareous; pH 9.4; gradual boundary.

C3—38 to 56 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) when moist; massive; extremely hard when dry, extremely firm when moist, very sticky and extremely plastic when wet; a few, faint, light yellowish-brown (2.5Y 6/4) mottles; moderately calcareous; pH 8.8; gradual boundary.

C4—56 to 65 inches, pale-olive (5Y 6/3) clay, and a few thin strata of clay loam, olive (5Y 4/3) when moist; massive; very hard when dry, very firm when moist, very sticky and very plastic when wet; moderately calcareous; pH 9.4.

McKenzie soils range from 1 to 3 in chroma. The A horizon is 2 to 6 inches thick. When dry, the surface has cracks 1 to 3 inches wide. Gypsum and other salt crystals may occur in the C horizon at any depth. On the outer margins of lake basins, the C horizon may have strata of loam and sandy loam below a depth of 48 inches.

McKenzie clay, 0 to 1 percent slopes (Mk).—This soil occurs in the dry lake basin between Acton and Broadview and west of Shepherd. Drainageways 1 to 2 feet deep carry runoff water into the basin. On the east side of these

drainageways are a few clay dunes 5 to 10 feet high and ½ acre to 2 acres in size. Included with this soil in mapping are small areas of Vananda soils.

This soil is well suited to range. Foxtail barley and annual weeds grow in drainageways and in areas where water collects. In wet years hay can be cut in some areas. (Capability unit VIw-2, dryland; Overflow range site, 10- to 14-inch precipitation zone)

McRae Series

The McRae series consists of deep, well-drained, nearly level to strongly sloping, calcareous soils on terraces, fans, and valley sides. These soils formed in loamy alluvium. The native vegetation is needle-and-thread, blue grama, broom snakeweed, western wheatgrass, big sagebrush, silver sagebrush, and winterfat. Elevation ranges from 2,900 to 4,000 feet. Annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 130 days. McRae soils are associated with Hysham, Fort Collins, and Haverson soils in stream valleys and with Bainville soils on shale uplands.

In a typical profile, the surface layer and subsoil are grayish-brown loam about 9 inches thick. The lower part of the subsoil is calcareous. The substratum is pale-yellow or pale-olive loam and fine sandy loam. It is strongly calcareous and contains a few, light-gray spots of lime.

Permeability is moderate, and the available water capacity is 8 to 10 inches. The organic-matter content and fertility are moderate.

These soils are used for dry and irrigated farming and for range. Wheat, barley, and hay are dryfarmed. Irrigated crops are sugar beets, dry beans, corn for silage, small grains, and hay.

Typical profile of McRae loam, 0 to 1 percent slopes, 1,350 feet south and 330 feet east of W¼ corner of section 19, T. 4 N., R. 33 E.:

Ap—0 to 5 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; moderate, medium and thick, platy structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; noncalcareous; pH 7.8; clear boundary.

B—5 to 9 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure; dark stains on ped faces; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; calcareous in lower part; pH 8.4; clear boundary.

C1ca—9 to 34 inches, pale-yellow (5Y 7/3) loam, olive (5Y 5/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; strongly calcareous; a few light-gray spots of lime; pH 8.4; gradual boundary.

C2—34 to 54 inches, pale-olive (5Y 6/3) loam, olive (5Y 5/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; strongly calcareous; pH 8.4; clear boundary.

C3—54 to 76 inches, pale-olive (5Y 6/3) fine sandy loam and stratified loam, olive (5Y 5/3) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; strongly calcareous; pH 8.4.

The McRae soils range from 2.5Y to 5Y in hue and are 2 or 3 in chroma. Texture in the C horizon varies most in soils on small fans on the gravel-capped uplands and least in nearly level soils on stream terraces. Pebbles are scattered on the surface of soils on fans on gravel-capped uplands. Depth to the C1ca horizon is 4 to 9 inches. Depth to shale in some areas is 48 to 76 inches or more.

McRae loam, 0 to 1 percent slopes (Mm).—This soil is on terraces and fans in valleys of rivers and large creeks. Slopes are less than 1 percent and runoff is slow. The risk of soil blowing is slight to moderate. The profile of this soil is typical for the series. Included with this soil in mapping are Fort Collins soils on large terraces.

This soil is used for dry and irrigated farming and for range. (Capability unit I-1, irrigated; IIIc-1, dryland; Silty range site, 10- to 14-inch precipitation zone)

McRae loam, 1 to 4 percent slopes (Mn).—This soil is on smooth fans and terraces in upland valleys and at the mouths of large valleys of streams tributary to the Yellowstone River. The profile is similar to that typical for the series. Gravel occurs on the surface in valleys that drain gravel-capped uplands. Slopes are mainly 2 percent. Slopes of 4 percent occur along large drainageways and on the peaks of fans. Runoff is slow, and the risk of water erosion is slight. The risk of soil blowing is moderate. Included in mapping are Haverson soils that lie in irregularly shaped strips next to channels of intermittent streams.

This soil is used for dry and irrigated farming. (Capability unit IIe-1, irrigated; IIIe-5, dryland; Silty range site, 10- to 14-inch precipitation zone)

McRae loam, 4 to 7 percent slopes (Mo).—This soil occurs in small areas on fans and sides of valleys along streams that are tributaries of the Yellowstone River. The profile is similar to that typical for the series. A few pebbles occur on the surface where the valleys drain gravel-capped uplands. Slopes are 4 and 5 percent on the lower parts of the fans and 6 and 7 percent on the upper parts. Runoff is medium. The risk of water erosion and soil blowing is moderate. In some places this soil has been damaged by runoff from steep soils on uplands.

This soil is used for dry and irrigated farming and for range. Irrigated crops are small grains, hay, and pasture. (Capability unit IIIe-2, irrigated; IIIe-5, dryland; Silty range site, 10- to 14-inch precipitation zone)

McRae loam, 7 to 15 percent slopes (Mr).—This soil is north of the Yellowstone River in deep valleys that are ½ to ¾ mile wide. It occupies valley sides and bottoms below steep shale and sandstone escarpments that form the valley rims. Soil areas are 200 to 400 feet wide and less than half a mile long. The profile of this soil is similar to the one described as typical for the series, but the depth to underlying shale ranges from 48 to 72 inches. Slopes are mainly 10 percent on the lower sides of the valleys and 15 percent immediately below the valley rims. Runoff is rapid. In some places, this soil has been damaged by rill erosion. Runoff water from the steep uplands crosses most areas.

This soil is suited to range. The less steep areas of this McRae soil are dryfarmed. (Capability unit IVe 4, dryland; Silty range site, 10- to 14-inch precipitation zone)

McRae-Bainville loams, 7 to 15 percent slopes (Ms).—These soils occur in deep valleys that are rimmed by steep shale and sandstone escarpments. The valleys are ½ to ¾ mile wide. A few deep coulees extend from the valley bottom to the base of the valley rim. Erosion is active in the large coulees. The mapped areas are 30 to 60 percent McRae soils, 20 to 50 percent Bainville soils, and the rest

Worland soils. Each soil has a profile similar to that typical for its series. The shallow Bainville soil occupies scattered, isolated ridges, knolls, and hills. Rock crops out in areas of Bainville soil. Slopes of the Bainville soil are short and 10 to 15 percent, and runoff is rapid. The deep McRae soils are in drainageways and on gravelly fans and valley sides between the areas of Bainville soils. Some gravel is mixed into McRae soils that are below gravel-capped terraces on uplands. The McRae soils have slopes of 7 to 10 percent and medium runoff.

These soils are used for range. (Capability unit IVe 4, dryland; Silty range site, 10- to 14-inch precipitation zone)

McRae-Hysham loams, 0 to 1 percent slopes (Mt).—These soils occur on terraces and fans, mostly in the dry lake basin south of Broadview. The mapped areas are 55 to 75 percent McRae soils and 25 to 45 percent Hysham soils. Included in mapping are small patches of Lohmiller soils. Also included are areas of Hysham silty clay loam in swales and partly filled, level stream channels. Each soil has a profile similar to the one described as typical for its series.

The cultivated Hysham soil has a gray surface layer and is hard and cloddy. When this soil is wet, the clods slake to a glazed crust. In uncultivated areas of Hysham soil, plant growth is stunted and cover is sparse. Slopes are less than 1 percent, and runoff is slow. The risk of soil blowing is slight on the McRae soil.

These soils are used for dry and irrigated farming and for range. Wheat and barley are dryfarmed. Irrigated crops are sugar beets, silage corn, small grains, and hay. (Capability unit IIs–2, irrigated; IIIs–3, dryland; Silty range site, 10- to 14-inch precipitation zone)

McRae-Hysham loams, 1 to 3 percent slopes (Mu).—These soils are scattered in small areas on fans of small stream valleys north of the Yellowstone River. The mapped areas are 55 to 65 percent McRae soils, 20 to 30 percent Hysham soils, and about 15 percent Haverson soils. Each soil has a profile similar to the one described as typical for its series. Cultivated Hysham soil is hard and cloddy, but the clods slake to a glazed crust when wet. Slopes are mainly 2 and 3 percent. Runoff is slow on the McRae soil and medium on the Hysham soil. The risk of soil blowing and water erosion is slight on the McRae soil.

These soils are used for dry and irrigated farming and for range. (Capability unit IIe–1, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

McRae-Hysham loams, 3 to 6 percent slopes (Mv).—These soils occur on valley sides. Mapped areas are 70 to 80 percent McRae soils and 20 to 30 percent Hysham soils. Each soil has a profile similar to the one described as typical for its series. Slopes are mainly 5 percent and 250 feet long. Runoff is medium. The risk of water erosion is moderate on the McRae soil.

These soils are used for dry and irrigated farming and for range. Shallow-rooted crops are suited to the Hysham soil. (Capability unit IIIe–2, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Midway Series

The Midway series consists of well-drained, sloping to moderately steep, calcareous soils on eroded uplands. These soils are less than 20 inches deep over partly weathered clayey shale. The native vegetation is grasses and forbs. A few pine trees and skunkbush sumac grow on the steep north-facing slopes and in the deepest coulees. Elevation ranges from 2,900 to 4,100 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 118 to 130 days. Midway soils are associated with Bainville, Elso, and Razor soils.

In a typical profile, the surface layer is pale olive clay loam 6 inches thick. It is directly underlain by a pale-yellow heavy clay loam substratum that contains many chips of partly weathered shale. Depth to shale is 10 to 20 inches.

Permeability is slow, and the available water capacity is 2 to 4 inches. The organic-matter content and fertility are low.

Midway soils are used mostly for range. In some areas wheat and barley are dryfarmed in a crop-fallow system.

Typical profile of Midway clay loam, 4 to 7 percent slopes, 2,000 feet south and 1,700 feet west of the NE. corner of section 5, T. 5 N., R. 35 E.:

Ap—0 to 6 inches, pale-olive (5Y 6/3) clay loam, olive (5Y 5/4) when moist; moderate, medium, platy structure that breaks to weak, fine, granular; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; moderately calcareous; pH 8.4; gradual, wavy boundary.

C1—6 to 12 inches, pale-yellow (5Y 7/3) heavy clay loam, olive (5Y 5/5) when moist; strong, medium, platy structure; hard when dry, firm when moist, sticky and plastic when wet; many partly weathered shale chips; moderately calcareous; pH 8.4; gradual, wavy boundary.

C2—12 to 30 inches, pale-olive (5Y 6/3), partly weathered platy shale, pale olive (5Y 6/3) when moist; lime coatings on the under side of shale chips; strongly calcareous; pH 8.4; wavy boundary.

C3—30 inches, platy shale.

Midway soils range from 2.5Y to 5Y in hue and from 2 to 4 in chroma. The C horizon is 35 to 45 percent clay.

Midway-Razor clay loams, 4 to 7 percent slopes (Mw).—These soils are on undulating to rolling uplands that separate major valleys. About 70 percent of the unit is Midway clay loam, and 30 percent is Razor clay loam. Each soil has a profile similar to the one described as typical of its series. The Midway soil is on the crest and sides of ridges and hills. The Razor soil is on the low, broad ridges and knolls and the smooth hollows between the ridges and hills. It has slopes of 4 to 6 percent. Included with these soils in mapping are areas of Midway soil that have slopes of 7 to 10 percent. Runoff is medium, and the risk of water erosion is moderate.

These soils are suited to range and to wheat and barley dryfarmed in a crop-fallow system. (Capability unit IVe–4, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Midway-Shale outcrop complex (My).—The Midway soil lies in patches around Shale outcrop in deep, narrow valleys rimmed by shale escarpments, in deep drainageways, and on eroded ridges, pinnacles, and buttes.

The complex consists of 50 percent Midway clay loam, 25 percent Shale outcrop, and 25 percent Lohmiller and Bainville soils. The Midway and Bainville soils lie on the broader ridgetops and knolls that are not separated by

deep drainageways. These soils have slopes of 5 to 25 percent. Shale outcrop occurs on nearly vertical valley rims, on the walls of deep valleys, and on sharp ridges and pinnacles that are separated by deep, narrow drainageways. Slopes are 25 to 50 percent. Included in mapping areas where shale crops out are thin layers of sandstone that break off in slabs and are scattered on lower slopes of the valleys. Lohmiller soils are on the lower sides and bottom of the widest valleys and have slopes of 5 to 15 percent.

Runoff is rapid, and water erosion is active where shale crops out. These areas contribute large amounts of runoff water and silt to the intermittent streams that drain into the Yellowstone River. This complex erodes easily where the plant cover is removed.

This complex is used for range. (Midway soil is in capability unit VIe-4, dryland; Thin Clayey range site, 10- to 14-inch precipitation zone; Shale outcrop is in capability unit VIIs-3, dryland; Shale range site, 10- to 14-inch precipitation zone)

Oburn Series

The Oburn series consists of well-drained, level to gently sloping soils on high terraces. These soils formed in clayey alluvium and are underlain by very gravelly sand. The native vegetation is mainly western wheatgrass, prairie junegrass, Sandberg bluegrass, sagebrush, and sagewort. Elevation ranges from 3,200 to 4,500 feet. The annual precipitation is 14 to 16 inches, the mean annual temperature is 42 to 44° F., and the frost-free season is about 122 days. Oburn soils are associated with Shaak, Shonkin, and Danvers soils.

In a typical profile, the surface layer is brownish-gray silt loam 6 inches thick. The subsoil is dark grayish-brown silty clay and dark-brown clay 13 inches thick. The calcareous substratum is light brownish-gray clay in the upper part and very gravelly loam or sandy loam in the lower part. Lime and crystals of gypsum occur at a depth of 14 inches.

Permeability is slow, and the available water capacity is 5 to 7 inches. The risk of water erosion and soil blowing is low. The fertility is high.

These soils are used for dryfarming and for range.

Typical profile of Oburn silt loam, 0 to 1 percent slopes, 150 feet south and 125 feet east of the N¼ corner of section 9, T. 2 S., R. 27 E.:

A21—0 to 1 inch, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; a few pebbles; pH 7.8; clear, smooth boundary.

A22—1 to 6 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; strong, thin, platy structure that breaks to weak, fine, crumb; soft when dry, friable when moist, nonsticky and nonplastic when wet; when dry, structure plates are light gray (10YR 7/2) on top and light brownish gray (10YR 6/2) on bottom; a few pebbles; noncalcareous; pH 7.8; abrupt, smooth boundary.

B1—6 to 7 inches, dark grayish-brown (10YR 4/2) silty clay, dark brown (10YR 3/3) when moist; strong, very fine, subangular blocky structure arranged as medium plates; very hard when dry, firm when moist, sticky and very plastic when wet; structure plates are light brownish gray (10YR 6/2) when dry and are coated with silica; noncalcareous; pH 7.8; clear, wavy boundary.

B21t—7 to 10 inches, dark grayish-brown (10YR 4/2) clay, dark brown (10YR 3/3) when moist; strong, medium, columnar structure; thin, gray cap on some of the prisms; very hard when dry, firm when moist, sticky and very plastic when wet; thick, continuous clay films on all ped faces; plant roots between the structure columns; pH 7.8; clear, wavy boundary.

B22t—10 to 14 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) when moist; strong, medium and coarse, prismatic structure; extremely hard when dry, firm when moist, sticky and very plastic when wet; thick, continuous clay films on all ped faces; noncalcareous; pH 7.8; gradual, wavy boundary.

B3—14 to 19 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure that breaks to moderate, medium, blocky; extremely hard when dry, firm when moist, sticky and very plastic when wet; moderately calcareous; pH 8.4; gradual boundary.

C1ca—19 to 24 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; weak, medium, prismatic structure that breaks to weak, medium, blocky; extremely hard when dry, firm when moist, sticky and very plastic when wet; moderately calcareous; common lime films and nodules; a few pebbles having lime undercrusts; pH 9.0; gradual boundary.

C2—24 to 36 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; weak, medium, prismatic structure that breaks to weak, medium, blocky; hard when dry, firm when moist, sticky and very plastic when wet; moderately calcareous; common, fine nodules and threads of lime; peds coated with crystals of gypsum; pH 9.0; clear, irregular boundary.

IIC3—36 to 40 inches, very gravelly loam that is 60 percent pebbles, by volume.

IIC4—40 to 60 inches, very gravelly sandy loam that is 75 percent pebbles, by volume.

Oburn soils range from 10YR to 2.5Y in hue and from 2 to 4 in chroma. In cultivated fields, the Ap horizon is clay loam and is cloddy. The A horizon is loam or silt loam 3 to 7 inches thick. The B horizon is 10 to 18 inches thick. Earth-filled gravel is below a depth of 30 inches. Scattered pebbles occur in all horizons in places.

Oburn-Shaak complex, 0 to 1 percent slopes (Oh).—This complex occurs on smooth terraces that are underlain by very gravelly sand. The complex is 55 percent Oburn silt loam and 45 percent Shaak silty clay loam. Each soil has the profile typical for its series. The Oburn soils occur in areas where runoff is slow, and the Shaak soils occur in areas that are well drained. Water erosion or soil blowing is not a hazard, but the Oburn soil may be ponded for several days after snow melts or after heavy rain. Included in mapping are Shonkin and Hydro soils in potholes.

This complex is suited to wheat and barley dryfarmed in a crop-fallow system. (Capability unit IIs-4, dryland; Silty range site, 15- to 19-inch precipitation zone)

Oburn-Shaak complex, 1 to 4 percent slopes (Os).—These soils are on high terraces that are drained by broad drainageways less than 10 feet deep. The soils are underlain by very gravelly sand. The complex is 40 percent Oburn silt loam, 30 percent Shaak silty clay loam, and 30 percent Danvers, Shonkin, and Hydro soils. The profile of each soil has the minimum range of features for its series. The Oburn and Shonkin soils are in troughs and are nearly level, and the Shaak and Danvers soils are on

crests and have 2 percent slopes in most places. Some slopes of 4 percent occur on terrace edges that are cut by the main drainageways. Runoff is medium on the Shaak soil and slow on the Oburn soil. The Shonkin soil may be ponded for several days after snow melts in spring.

This complex is suited to wheat and barley dryfarmed in a crop-fallow system and to range. (Capability unit IIs-4, dryland; Silty range site, 15- to 19-inch precipitation zone)

Pierre Series

The Pierre series consists of moderately deep, sloping to moderately steep clay soils that formed in material weathered from underlying platy clay shale. These soils occur on uplands in the southeastern and northeastern parts of the county and east of Acton. The native vegetation is mainly western wheatgrass, green needlegrass, and sagebrush. Elevation ranges from 3,200 to 4,600 feet, and the annual precipitation is 11 to 14 inches. Pierre soils are associated with Lismas, Vananda, and Kyle soils.

In a typical profile, the surface layer is light olive-brown silty clay and clay 4 inches thick. The subsoil is olive clay 6 inches thick. The substratum is strongly calcareous olive clay that contains light-gray specks and mottles of lime. The lower substratum contains fine shale chips and some crystals of gypsum. Depth to shale bedrock is 31 inches.

Permeability is slow, and the available water capacity is 3 to 6 inches. The risk of soil blowing is moderate to high, and the fertility is moderate.

Pierre soils are suited to dryfarmed small grains and to range.

Typical profile of Pierre clay, 4 to 7 percent slopes, about 1,500 feet east of the NW. corner of section 9, T. 2 N., R. 25 E., about 50 feet south of road:

A11—0 to 2 inches, light olive-brown (2.5Y 5/3) silty clay, olive brown (2.5Y 4/3) when moist; strong, fine, granular structure; very hard when dry, friable when moist, sticky and plastic when wet; weakly calcareous; pH 8.4; clear, smooth boundary.

A12—2 to 4 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) when moist; strong, very fine, subangular blocky structure; extremely hard when dry, firm when moist, sticky and very plastic when wet; strongly calcareous; pH 8.4; gradual, wavy boundary.

B2—4 to 10 inches, olive (5Y 5/3) clay, olive (5Y 4/3) when moist; strong, fine, blocky structure; extremely hard when dry, firm when moist, sticky and plastic when wet; strongly calcareous; pH 8.4; gradual, wavy boundary.

C1—10 to 16 inches, olive (5Y 5/3) clay, olive (5Y 4/3) when moist; moderate, fine and medium, blocky structure; extremely hard when dry, firm when moist, sticky and very plastic when wet; a few fine nodules of lime; strongly calcareous; pH 8.4; gradual, wavy boundary.

C2—16 to 19 inches, olive (5Y 5/3) clay, olive (5Y 4/3) when moist; very weak, coarse, blocky structure; extremely hard when dry, firm when moist, sticky and very plastic when wet; a few fine chips of shale; strongly calcareous; pH 8.4; gradual boundary.

C3—19 to 24 inches, olive-gray (5Y 5/2) clay, olive (5Y 4/3) when moist; massive; many unweathered and weathered chips of shale; strongly calcareous; pH 8.4; gradual, wavy boundary.

C4—24 to 31 inches, gray and dark-gray (5Y 5/1 and 4/1) clay shale, very dark gray (5Y 3/1) or black (5Y 2/1) when moist; common nests and seams of gypsum; gradual boundary.

C5—31 inches, clay shale.

The soil ranges from 2.5Y to 5Y in hue and is 2 to 3 in chroma. Shale chips may occur at a depth of 10 inches or less. Depth to shale bedrock ranges from 20 to 40 inches.

Pierre clay, 4 to 7 percent slopes (Pc).—This soil occurs on uplands throughout the county. It formed in clay shale. Smooth ridges and hills are separated by shallow, widely spaced, well-grassed drainageways 15 to 25 feet deep. The profile is typical for the series. On the terraces south of the Yellowstone River, rounded pebbles are scattered on the surface. Slopes are dominantly 6 percent, runoff is medium, and the risk of water erosion is moderate. Included in mapping are Kyle soils, shale outcrops, and patches of Lismas soils that have pebbles on the surface.

This soil is suited to range and dryfarmed small grains. (Capability unit IVe-5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Pierre-Lismas clays, 7 to 15 percent slopes (Pl).—These soils occupy areas 20 to 200 acres in size on dissected shale uplands. Narrow ridges and steep hills are separated by deep, narrow drainageways. The unit is 55 percent Pierre clay and 35 percent Lismas clay. Each soil has a profile similar to the one typical for its series. The Pierre soil has 7 to 10 percent slopes and occurs on the crests of broad ridges and hills. The Lismas soil has 10 to 15 percent slopes and occurs on sharp, narrow ridges and the sides of narrow, deep drainageways. Shale crops out on the bottom of the deepest drainageways. Runoff is rapid, and the risk of water erosion is moderate. Included with these soils in mapping are small spots of Kyle soils at the heads of drainageways.

These soils are used for range. (Pierre clay is in capability unit VIe-4, dryland; Clayey range site, 10- to 14-inch precipitation zone; Lismas clay is in capability unit VIIs-1, dryland; Shale range site, 10- to 14-inch precipitation zone)

Razor Series

The Razor series consists of well-drained, moderately deep, gently sloping to sloping soils on shale uplands. The soils are on broad ridgetops and on shallow, concave slopes between ridges and knolls. The soils formed in material weathered from platy shale. The native vegetation is mainly western wheatgrass, green needlegrass, and sagebrush. Elevation ranges from 3,000 to 3,800 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 120 to 128 days. Razor soils are associated with Bainville, Elso, and Midway soils.

In a typical profile, the surface layer is pale-brown heavy loam 3 inches thick. The subsoil is brown clay loam about 8 inches thick. The calcareous substratum is light yellowish-brown clay loam that contains light-gray specks of lime and some shale fragments. Depth to shale is about 29 inches.

Permeability is moderately slow, and the available water capacity is 4 to 6 inches. The organic-matter content and fertility are moderate.

These soils are suited to range and to wheat and barley dryfarmed in a crop-fallow system.

Typical profile of Razor clay loam, 2 to 7 percent slopes, about 75 feet north and 800 feet west of the SE. corner of section 32, T. 2 N., R. 24 E.:

A1—0 to 3 inches, pale-brown (10YR 6/3) heavy loam, dark brown (10YR 3/3) when moist; moderate, fine, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.3; clear, smooth boundary.

B21t—3 to 5 inches, dark-brown (10YR 4/3) heavy clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure that breaks to strong, very fine, subangular blocky; hard when dry, firm when moist, sticky and plastic when wet; moderately thick, patchy clay films on ped faces; noncalcareous; pH 7.3; clear, boundary.

B22t—5 to 8 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; moderately thick, patchy clay films on ped faces; moderately calcareous; pH 8.4; clear, wavy boundary.

B3ca—8 to 11 inches, pale-brown (10YR 6/3) clay loam, yellowish brown (10YR 5/4) when moist; moderate, medium, prismatic structure; hard when dry, very firm when moist, very sticky and very plastic when wet; a few fragments of weathered shale; strongly calcareous; pH 8.4; gradual, wavy boundary.

C1—11 to 18 inches, light yellowish-brown (2.5Y 6/3) clay loam, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, very firm when moist, very sticky and very plastic when wet; common lime nodules and shale fragments; strongly calcareous; pH 8.4; gradual, wavy boundary.

C2—18 to 29 inches, clay loam and lime-coated platy shale; plates 1/8 to 1/4 inch thick; pH 8.4.

C3—29 to 59 inches, fractured sandy and clay loam shale; weakly calcareous.

Razor soils range from 10YR to 5Y in hue. Chroma ranges from 2 in the A and B horizons to 4 in the C3 horizon. In value, the C3 horizon is 6 or 7 when dry and 5 or 6 when moist. The A horizon is loam to clay loam. The B horizon is 4 to 10 inches thick. Depth to the calcareous layer is 8 to 10 inches, and to shale, 20 to 40 inches.

Razor clay loam, 2 to 7 percent slopes (Ra).—This soil occurs on broad, low ridges and knolls at the head of major drainageways on uplands. The areas are 10 to 35 acres in size. The profile is typical for the series. In places the soil is underlain by siltstone and sandy shale. Slopes are dominantly 5 percent, and local relief is about 20 feet. Runoff is slow to medium, and the risk of erosion is moderate on cultivated soil.

This soil is suited to wheat and barley dryfarmed in a crop-fallow system and to range. (Capability unit IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Razor-Cushman complex, 2 to 4 percent slopes (Rc).—This complex occurs between major drainageways on uplands in the northern part of the county. The drainageways are broad and well grassed. Slopes are dominantly 2 to 3 percent and local relief is low. Runoff is slow, and the risk of water erosion and soil blowing is slight.

The complex is 60 percent Razor clay loam and 40 percent Cushman loam. Each soil has a profile similar to the one typical for its series except that the Razor soil has a surface layer 4 to 5 inches thick, is noncalcareous to a depth of 15 inches, and is more than 40 inches deep in some areas. Included in mapping are Worland soils where sandstone layers form part of the underlying bedrock.

This complex is suited to small grains dryfarmed in a crop-fallow system and to range. (Capability unit IIIe 5, dryland; Razor soil is in Clayey range site, 10- to 14-inch precipitation zone; Cushman soil is in Silty range site, 10- to 14-inch precipitation zone)

Riverwash

Riverwash (Re) occurs on the flood plains of the Yellowstone and Bighorn Rivers and Clarks Fork of the Yellowstone River. It consists of sand and gravel bars adjacent to the stream channel. The areas are unstable and frequently flooded. The risk of soil blowing is very high from late in summer until early in spring. The native vegetation consists of a few willows and annual weeds of no forage value.

This land type is suited only to wildlife, mainly waterfowl. (Capability unit VIIIs 1, dryland)

Rock Land

Rock land (Rk) occurs throughout the uplands, mainly north of the Yellowstone River. The largest area is the rimrock that extends from the north edge of Billings to the county line west of Laurel. It consists of barren or nearly barren rock that crops out along the rims of deep valleys. The typical outcrop is 50 to 100 feet high and consists of a layer of hard sandstone 50 to 75 feet thick and of one or more layers of soft shale. Soil material weathered from the shale and sandstone lies mixed with slabs and blocks of sandstone at the base of the cliffs. The native vegetation is sparse skunkbush, yucca, bunchgrass, ponderosa pine, and juniper trees. Included in mapping are Worland, Bainville, and Travessilla soils that lie in bands 50 to 400 feet wide along the cliff tops.

This land type is suited only to wildlife. (Capability unit VIIIs–1)

Ryegate Series

The Ryegate series consists of gently sloping to sloping, well-drained, moderately deep soils on uplands. They formed in sandy material weathered from sandstone. The native vegetation is grasses, sagebrush, and skunkbush sumac. Elevation ranges from 3,300 to 4,400 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days. Ryegate soils are associated with Lavina, Worland, and Travessilla soils.

In a typical profile the surface layer is grayish-brown fine sandy loam 4 inches thick. The subsoil is brownish fine sandy loam and heavy sandy clay loam 13 inches thick. The calcareous substratum is light yellowish-brown loam. Depth to sandstone bedrock is 30 inches.

Permeability is moderately slow, and the available water capacity is 3 to 5 inches. The risk of soil blowing is moderate. The organic-matter content and fertility are moderate.

These soils are used for dryfarming and for range.

Typical profile of Ryegate fine sandy loam, 2 to 4 percent slopes, 65 feet south and 35 feet east of the NW. corner of section 10, T. 1 N., R. 25 E.:

A1 0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, dark brown (10YR 3/3) when moist; weak, medium, platy structure that breaks to moderate, fine, granular; slightly hard when dry, very friable when moist; abundant, clear sand grains; pH 7.3; abrupt boundary.

B1—4 to 9 inches, brown (10YR 5/3) heavy fine sandy loam, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure; hard when dry, very friable when moist; pH 7.3; clear boundary.

B21t—9 to 14 inches, yellowish-brown (10YR 5/4, coated) (10YR 5/6, crushed) heavy sandy clay loam, dark yellowish brown (10YR 3/4) when moist; strong, medium and coarse, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, friable when moist, sticky and plastic when wet; moderately thick, continuous clay films on ped faces; pH 7.3; gradual, wavy boundary.

B22t—14 to 17 inches, brown (10YR 5/3) heavy sandy clay loam, dark yellowish brown (10YR 4/4) coated, or yellowish brown (10YR 5/4) crushed, when moist; strong, medium and coarse, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, friable when moist, sticky and plastic when wet; moderately thick clay films on ped faces; pH 7.8; clear, irregular boundary.

Cca—17 to 25 inches, light yellowish-brown (2.5Y 6/3) loam that has pockets of sandy loam, light olive brown (2.5Y 5/3) when moist; weak, coarse, prismatic structure that breaks to weak, medium, blocky; very hard when dry, friable when moist; strongly calcareous; pH 8.4; abrupt, wavy boundary.

R 25 inches, indurated sandstone.

Ryegate soils range from 10YR to 2.5Y in hue and from 2 to 4 in chroma. The B horizon is 9 to 14 inches thick. Depth to the Cca horizon is 15 to 19 inches. Soils that are shallow over sandstone are noncalcareous in some areas. A few sandstone fragments may occur at depths of more than 15 inches. Depth to sandstone is 20 to 40 inches.

Ryegate fine sandy loam, 2 to 4 percent slopes (Rn).—This soil occurs on smooth, sandstone uplands northwest of Billings and along the county line west of Pryor Creek. The profile of this soil is the one described as typical for the series. The soil near Pryor Creek contains no lime and has a dark grayish-brown surface layer. The risk of soil blowing is moderate on dry, cultivated soil. Some cultivated soil has been moderately eroded. Included in mapping are small spots of Travessilla, Worland, and Lavina soils that normally have sandstone fragments on the surface.

This soil is used for dryfarming and for range. (Capability unit IIIe-7, dryland; Sandy range site, 10- to 14-inch precipitation zone)

Ryegate-Travessilla loams, 2 to 4 percent slopes (Rr).—This complex occurs on uplands where the bedrock is hard sandstone and shale. It is 60 percent Ryegate loam and 40 percent Travessilla loam. Where the surface is crossed by shallow drainageways, Travessilla loam is on the higher parts of the ridges and knolls between the drainageways. In sloping areas not broken by drainage ways the pattern of these soils is unpredictable. Each soil has a profile similar to that typical for its series except that the surface layer is loam rather than fine sandy loam. Thin, hard pieces of sandstone are scattered on the surface of the Travessilla soil.

Runoff is slow, and slopes are mainly 2 percent. Some slopes of 4 percent occur along the deepest drainageways. Soil blowing is a moderate hazard on cultivated soils.

Included with these soils in mapping are rock outcrops, Lavina and Wormser soils, and 1/4-acre spots of Gilt Edge soils in shallow depressions.

This complex is used mostly for range. Wheat and barley are dryfarmed in a few small areas. (Capability unit VIe-1, dryland; Ryegate soil is in Silty range site, 10- to 14 inch precipitation zone; Travessilla soil is in Shallow Limy range site, 10- to 14-inch precipitation zone)

Ryegate-Travessilla loams, 4 to 7 percent slopes (Rt).—This complex occurs on uplands where the bedrock is hard shale and sandstone. It is 55 percent Ryegate loam and 45 percent Travessilla loam. In most places these soils are along deep drainageways that cut through the hard sandstone. The profile of each soil is similar to the one described as typical for its series except that the surface layer is loam rather than fine sandy loam. Rock crops out in the areas of Travessilla loam. Runoff is medium. Slopes are short and are mainly 4 and 5 percent. The risk of soil blowing is moderate on cultivated soils.

These soils are used mostly for range. Wheat and barley are dryfarmed in a few areas. (Capability unit VIe-1, dryland; Ryegate soil is in Silty range site, 10- to 14-inch precipitation zone; Travessilla soil is in Shallow Limy range site, 10- to 14-inch precipitation zone)

Sage Series

The Sage series consists of deep, nearly level, poorly drained, saline clay soils that formed in alluvium on terraces and fans of large stream valleys. A permanent water table is at or near the surface, and a surface crust of salt occurs on all these soils. The native vegetation is salt-tolerant annual weeds, western wheatgrass, and greasewood. Elevation ranges from 3,000 to 3,500 feet. The annual precipitation is 12 to 14 inches, and the mean annual temperature is 45 to 47° F. Sage soils are associated with Bone, Pierre, and Lismas soils.

In a typical profile, the surface layer is light olive-gray silty clay that contains many salt crystals. The substratum is olive silty clay and heavy clay several feet thick. It also contains many salt crystals.

Permeability is very slow. The organic-matter content is low, and the soil is nearly barren.

Typical profile of Sage clay, 0 to 1 percent slopes, 200 feet south and 1,050 feet west of the NE. corner of section 8, T. 2 N., R. 27 E.:

A—0 to 1/4 inch, light olive-gray (5Y 6/2) silty clay, olive (5Y 5/3) when moist; surface crust of salt crystals; soft when dry, friable when moist; very sticky and plastic when wet; weakly calcareous; pH 9.0; abrupt, smooth boundary.

C1sa—1/4 to 3 inches, olive (5Y 5/3) silty clay, olive (5Y 4/3) when moist; moderate, very fine, granular structure; soft when dry, friable when moist, very sticky and plastic when wet; numerous salt crystals; weakly calcareous; pH 8.8; clear, smooth boundary.

C2sa—3 to 21 inches, light olive-gray (5Y 6/2) heavy clay, olive (5Y 4/3) when moist; weak granular structure; extremely hard when dry, very firm when moist, very sticky and very plastic when wet; mod-

erately calcareous; pH 8.7; common seams and nests of gypsum and other salts; gradual boundary.

C3sa—21 to 60 inches, pale-olive (5Y 6/3) heavy clay, olive (5Y 5/3) when moist; massive; extremely hard when dry, very firm when moist; very sticky and very plastic when wet; common seams and nests of gypsum and other salts; moderately calcareous; pH 8.8.

The Sage soils range from silty clay to clay. A white salt crust forms on the surface when the soil is dry to a depth of 3 or 4 inches. Depth to the water table is 0 to 36 inches. In all layers the pH ranges from 8.5 to 9.2.

Sage clay, 0 to 1 percent slopes (Sa).—This soil is on fans and terraces, mainly in the irrigated parts of the Yellowstone River Valley and in the intermittent-stream valleys in the northern part of the county. The soil occurs below irrigation canals that are constructed on saline shale bedrock and in swales and drainageways that are used as outlets for irrigation waste water. The water table is highest late in the growing season.

This soil is nearly barren and continually wet. (Capability unit VIIIw–2, dryland)

Shaak Series

The Shaak series consists of deep, well-drained, nearly level to gently sloping soils on high terraces along Pryor, Indian, Arrow, and Spring Creeks. Elevation ranges from 3,200 to 4,800 feet. The annual precipitation is 14 to 16 inches, the mean annual temperature is 42 to 44° F., and the frost-free season is 110 to 125 days. The Shaak soils are associated with Danvers and Oburn soils on terraces.

In a typical profile, the cultivated surface layer is dark grayish-brown silty clay loam 5 inches thick. The subsoil is brown to light yellowish-brown silty clay 11 inches thick. The lower part of the subsoil is calcareous. The calcareous substratum is grayish silty clay loam, clay loam, and sandy loam. The upper part of the substratum contains light-gray spots of segregated lime. Depth to gravelly sandy loam is 48 inches.

Permeability is slow, and the available water capacity is 8 to 10 inches. The fertility is high.

These soils are suited to dryfarmed small grains and to range.

Typical profile of Shaak silty clay loam, 0 to 1 percent slopes, in a cultivated field, about 1,000 feet north of old building site, 2,000 feet east of the SW. corner of section 32, T. 2 S., R. 28 E.:

Ap—0 to 5 inches, dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; cloddy; breaks to moderate, fine, blocky; very hard when dry, firm when moist, sticky and very plastic when wet; noncalcareous; pH 7.3; abrupt boundary.

B21t—5 to 10 inches, brown (10YR 5/3) heavy silty clay, dark brown (10YR 4/3) when moist; strong, medium, prismatic structure that breaks to strong, fine and very fine, blocky; moderately thick, continuous clay films on ped faces; very hard when dry, firm when moist, sticky and very plastic when wet; noncalcareous; pH 7.3; clear boundary.

B22t—10 to 13 inches, light olive-brown (2.5Y 5/3) heavy silty clay, olive brown (2.5Y 4/3) when moist; strong, medium, prismatic structure that breaks to strong, fine, blocky; very hard when dry, firm when moist, sticky and very plastic when wet; moderately thick, continuous clay films on ped faces; noncalcareous; pH 7.8; clear boundary.

B3—13 to 16 inches, light yellowish-brown (2.5Y 6/3) light silty clay, light olive brown (2.5Y 5/4) when moist; moderate, medium, prismatic structure that breaks to strong, medium and fine, blocky; very hard when dry, friable when moist, sticky and plastic when wet; strongly calcareous; pH 8.4; clear boundary.

C1ca—16 to 25 inches, light brownish-gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/3) when moist; moderate, medium, blocky structure; hard when dry, friable when moist, sticky and plastic when wet; strongly calcareous; pH 8.4; a few lime nodules and a few pebbles that have lime crusts on the under side; gradual boundary.

C2ca—25 to 40 inches, light olive-gray (5Y 6/2) light clay loam, olive (5Y 5/3) when moist; massive; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; strongly calcareous; pH 8.4; a few lime nodules and a few pebbles that have lime crusts on the under side; gradual boundary.

C3—40 to 50 inches, olive gray (5Y 5/2) gravelly sandy loam, olive gray (5Y 4/2) when moist; massive; very strongly calcareous; pH 8.4; gradual boundary.

IIC4—50 to 56 inches, gravelly sandy loam; gravel content increases with depth.

In undisturbed areas, the A horizon is silt loam 2 to 5 inches thick. The B horizon is 10 to 20 inches thick. The B horizon ranges from 10YR to 2.5Y in hue and from 2 to 4 in chroma. Depth to the Cca horizon is 12 to 18 inches. Gravel occurs on the surface in some areas.

Shaak silty clay loam, 0 to 1 percent slopes (Sh).—This soil occurs on high terraces along the south county line and south of Ballantine. The profile of this soil is the one described as typical for the series. Runoff is very slow or ponded. Drainageways are not distinct, and nearly all runoff collects in shallow depressions and nearly level basins. Included in mapping are Shonkin soils in potholes and Oburn soils that are nearly level. These soils make up 5 to 10 percent of some mapped areas.

Nearly all this soil is used for dryfarmed wheat, barley, and alfalfa hay. Small areas in the valley of Pryor Creek are used for irrigated small grains and alfalfa. (Capability unit IIe–2, dryland; Silty range site, 15- to 19-inch precipitation zone)

Shaak silty clay loam, 1 to 4 percent slopes (Sk).—This soil occupies gently undulating high terraces where local relief is 4 or 5 feet. Individual areas range from 40 to 200 acres in size. Slopes are short, runoff is slow, and the risk of water erosion is slight. Where slopes are 4 percent, the subsoil is thin and lime is near the surface. On knolls and ridge crests, the depth to gravel is slightly less than 48 inches in some places. Included with this soil in mapping are nearly level Oburn soils in shallow drainageways and Danvers soils on narrow ridges and upper parts of steep slopes.

Nearly all of this soil is used for dryfarmed wheat and barley. Small areas along terrace edges are used for range. (Capability unit IIe–2, dryland; Silty range site, 15- to 19-inch precipitation zone)

Shale Outcrop

Shale outcrop is mapped separately and also in a complex with Midway soils.

Shale outcrop (S).—This land type consists of shale hills and escarpments on uplands south of the Yellowstone

River. Steep ridges, buttes, pinnacles, and escarpments are separated by deep drainageways and gullies. Slopes are irregular, are short, and range from 8 to 60 percent. Runoff is very rapid, and erosion is active on the steep slopes. The native vegetation is salt-tolerant shrubs, western wheatgrass, and some stunted cedar trees. Included in mapping are Lismas soils on wide ridges and in heads of drainageways.

Forage plants grow on the Lismas soil. Only deer and sheep can graze very steep slopes. (Capability unit VIIs-3, dryland; Shale range site, 10- to 14-inch precipitation zone)

Shale outcrop-Midway complex, 15 to 35 percent slopes (Sm).—This complex occurs on rims and sides of deep valleys. The complex is 30 to 70 percent shale outcrop, and the rest is Midway clay. The shale outcrop occupies the rims and upper sides of valleys, gullies, and drainageways. Slopes range from 25 to 60 percent and are 75 to 175 feet long. Midway clay occupies narrow ridgetops between deep drainageways and has slopes of 15 to 25 percent. Runoff is rapid to very rapid, and the risk of erosion is severe. Large amounts of water and silt flow into the main intermittent streams that empty into the Yellowstone River.

Some areas are used for range. (Shale outcrop is in capability unit VIIs–3, dryland; Shale range site, 10- to 14-inch precipitation zone; Midway soil is in capability unit VIe–4, dryland; Thin Clayey range site, 10- to 14-inch precipitation zone)

Shonkin Series

The Shonkin series consists of somewhat poorly drained, nearly level soils in swales and undrained depressions in uplands. The soils formed in mixed alluvium. The mean annual temperature is 46° F., the annual precipitation is 14 to 16 inches, and the frost-free season is 120 to 125 days. Shonkin soils are associated with Danvers, Shaak, and Oburn soils on high gravel terraces south of the Yellowstone River.

In a typical profile, the plow layer is light brownish-gray loam and clay loam 9 inches thick. The subsoil is grayish-brown and olive-brown heavy clay about 23 inches thick. The substratum is light yellowish-brown, calcareous clay loam and loam speckled with light-gray lime.

Permeability is slow, and the available water capacity is 8 to 10 inches. The soils are ponded by runoff water from surrounding soils when snow melts or rain is heavy. Fertility is moderate. Roots penetrate the upper 12 inches of the soils easily and the subsoil slowly.

Shonkin soils are suited to dryfarmed small grains and to range.

Typical profile of cultivated Shonkin loam, 0 to 1 percent slopes, 1,750 feet north of the SW. corner of section 31, T. 1 N., R. 29 E., 115 feet east of the road fence:

Ap—0 to 7 inches, light brownish-gray (2.5Y 6/2) loam, very dark grayish brown (2.5Y 3/2) when moist; massive; upper 2 inches is vesicular; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; a few, fine, dark yellowish-brown (10YR 4/4 and 3/4) mottles when moist; noncalcareous; pH 6.4; abrupt boundary.

A2—7 to 9 inches, light brownish-gray (2.5Y 6/2) light clay loam, very dark grayish brown (2.5Y 3/2) when moist; moderate, medium, platy structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common, fine, dark yellowish-brown (10YR 4/4 and 3/4) mottles when moist; A2 horizon tongues into the B2t horizon about 1½ inches; pH 6.5; abrupt, wavy boundary.

B2t—9 to 22 inches, grayish-brown (2.5Y 5/2) heavy clay, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure; extremely hard when dry, extremely firm when moist, very sticky and extremely plastic when wet; thick continuous clay films on ped faces; pH 7.3; gradual, wavy boundary.

B3—22 to 32 inches, olive-brown (2.5Y 4/3) heavy clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic structure that breaks to strong, medium, blocky; extremely hard when dry, extremely firm when moist, very sticky and extremely plastic when wet; thick continuous clay films on ped faces; weakly calcareous; pH 7.8; clear, wavy boundary.

C1ca—32 to 36 inches, light yellowish-brown (2.5Y 6/3) heavy clay loam, light olive brown (2.5Y 5/3) when moist; weak, coarse, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; common lime nodules; moderately calcareous; pH 8.4; gradual boundary.

C2—36 to 55 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/4) when moist; massive; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; common lime nodules; very strongly calcareous; pH 8.4; gradual boundary.

C3—55 to 62 inches, light yellowish-brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/4) when moist; massive; very strongly calcareous; pH 8.4.

The A2 horizon is 2 to 10 inches thick. Distinct mottles occur in the lower part of this horizon. Where undisturbed, the A horizon is vesicular and has platy structure. Gravel occurs on the surface of soils in shallow depressions. The B horizon is 17 to 23 inches thick and 50 to 65 percent clay. The upper 2 inches of the B horizon has prismatic structure that breaks to moderate, medium, platy. Depth to the Cca horizon is 20 to 36 inches. In many places a few pebbles occur throughout the profile.

Shonkin loam, 0 to 1 percent slopes (Sn).—This soil occurs in small, undrained swales and depressions on high terraces bordering the large stream valleys. The largest area is on the bench south of Ballantine and is drained by Arrow and Spring Creeks. Slope is 1 percent on the outer rim of the depressions and nearly level on the bottom.

Wheat and barley are dryfarmed, and small areas are used for range. Occasionally, spring floods damage the crops. (Capability unit IIIs–3, dryland; Overflow range site, 10- to 14-inch precipitation zone)

Shorey Series

The Shorey series consists of well-drained, gently sloping to sloping soils on fans and terraces in river valleys. The soils formed in mixed loamy alluvium and gravel from sedimentary and metamorphic rock. Elevation ranges from 2,900 to 3,400 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 47° F., and the frost-free season is 125 days. Shorey soils are associated with Clapper, Toluca, Keiser, and Wanetta soils.

In a typical profile, the surface layer is grayish-brown loam and gravelly loam 7 inches thick. The substratum

is very strongly calcareous gravelly loam, very fine sandy loam, and loam several feet thick. The substratum contains white spots of lime, and the pebbles and gravel are undercoated with lime.

Permeability is moderate, and the available water capacity is 5 to 7 inches. The organic-matter content and fertility are moderate.

These soils are used for dry and irrigated farming and for range.

Typical profile of Shorey gravelly loam, 1 to 4 percent slopes, in a road cut 430 feet east of S¼ corner of section 26, T. 1 S., R. 24 E.:

A11—0 to 4 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, crumb structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; 10 percent gravel, by volume; moderately calcareous; pH 7.8; gradual, wavy boundary.

A12—4 to 7 inches, grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure that breaks to weak, fine, blocky; hard when dry, friable when moist, sticky and plastic when wet; 15 percent gravel, by volume; moderately calcareous; pH 7.8; clear, wavy boundary.

C1ca—7 to 13 inches, pale-brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; 20 percent gravel, by volume; strongly calcareous; pH 8.4; a few coarse mottles of lime; clear, wavy boundary.

C2ca—13 to 17 inches, light-gray (10YR 7/2) gravelly loam, pale brown (10YR 6/3) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; 25 percent gravel, by volume; very strongly calcareous; pH 8.4; clear, wavy boundary.

C3ca—17 to 30 inches, white (2.5Y 8/2) gravelly loam, pale yellow (2.5Y 7/3) when moist; hard when dry, friable when moist, sticky and plastic when wet; 30 percent gravel, by volume; very strongly calcareous; pH 8.4; abrupt, wavy boundary.

IIC4—30 to 42 inches, light brownish-gray (2.5Y 6/2) very gravelly sandy clay loam, light olive brown (2.5Y 5/3) when moist; massive; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; 45 percent gravel, by volume; strongly calcareous; pH 8.4; gradual, wavy boundary.

IIIC5—42 to 48 inches, pale-yellow (2.5Y 7/3) very fine sandy loam, light olive brown (2.5Y 5/4) when moist; massive; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; a few pebbles; strongly calcareous; pH 8.4; gradual, wavy boundary.

IIIC6—48 to 54 inches, pale yellow (2.5Y 7/3) loam, light olive brown (2.5Y 5/4) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; 10 percent gravel, by volume; strongly calcareous; pH 8.4; clear, wavy boundary.

IIIC7—54 to 64 inches, light yellowish-brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; 5 percent gravel, by volume; strongly calcareous; pH 8.4.

Shorey soils range from 10YR to 5Y in hue. When the soil is dry, value in the Cca and C horizons ranges from 6 to 8; value is 6 or 7 when the soil is moist. Chroma ranges from 1 to 4 when the soil is dry and moist. The gravel content in the A horizon is 5 to 35 percent, but in the Cca and C horizons, it is 20 to 50 percent. The stratified layers range from clay loam to loamy sand.

Shorey gravelly loam, 1 to 4 percent slopes (So).—This soil occurs in areas 5 to 35 acres in size on fans and terraces northeast of Laurel and on the high terraces along the Yellowstone River Valley. Broad ridges and shallow watercourses separate deep drainageways that cross the fans and terraces. Some watercourses end on nearly level flats. The gravel content is low for the series, and the surface layer on steep knolls or ridge crests is light brownish gray. Slopes are short, uneven, and mainly 2 percent. Some 1 percent slopes occur on flat areas between low mounds and ridges. Runoff is slow, and the risk of soil blowing and water erosion is low. The organic-matter content and fertility are low to moderate.

These soils are used for irrigated sugar beets, dry beans, corn for silage, small grains, hay and pasture. Small areas are dryfarmed or used for range. (Capability unit IIe–1, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Shorey gravelly loam, 4 to 7 percent slopes (Sr).—This soil occurs on terraces that have been eroded into a pattern of low ridges and mounds separated by shallow, distinct watercourses. The gravel content in all layers is high for the series. The white subsoil is exposed in cultivated soils on narrow ridgetops. Slopes are short, uneven, and mainly 6 percent. Some 4 percent slopes occur on wide watercourses that are less than 5 feet deep. Runoff is medium, and the risk of water erosion is moderate.

In the vicinity of Laurel this soil is used for irrigated small grains, hay, and pasture. Elsewhere it is used for dryfarming and for range. (Capability unit IIIe 2, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Thurlow Series

The Thurlow series consists of deep, well-drained, nearly level to sloping soils on river terraces and fans where intermittent streams flow into the river valleys. They occur on the outer margins of the valleys, well above the present flood plains of the perennial streams. Elevation ranges from 3,000 to 3,600 feet. The annual precipitation is 12 to 13 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 125 days. Thurlow soils are associated with Fort Collins soils.

In a typical profile, the cultivated surface layer is grayish-brown heavy clay loam about 8 inches thick. The subsoil is grayish-brown and brownish-gray light clay, 9 inches thick. The calcareous substratum is light yellowish-brown to light-gray clay loam several feet thick.

Permeability is moderately slow, and the available water capacity is 9 to 11 inches. The organic-matter content is moderate and the fertility is high.

These soils are used for dry and irrigated farming and for range. Wheat and barley are dryfarmed in a crop-fallow system. Irrigated crops are corn for silage, dry beans, sugar beets, small grains, and hay.

Typical profile of cultivated Thurlow clay loam, 0 to 1 percent slopes, in a field, 990 feet south and 175 feet west of the center of section 15, T. 2 S., R. 23 E.:

Ap—0 to 8 inches, grayish-brown (2.5Y 5/2) heavy clay loam, dark grayish brown (2.5Y 4/2) when moist; sticky and plastic when wet; noncalcareous; pH 7.3; abrupt, smooth boundary.

B22t—8 to 13 inches, grayish-brown (2.5Y 5/2) light clay, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure that breaks to moderate, medium and fine, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; moderately thick, patchy clay films on ped faces; pH 7.8; gradual, wavy boundary.

B3ca—13 to 17 inches, light brownish-gray (2.5Y 6/2) light clay, light olive brown (2.5Y 5/3) when moist; weak, medium, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; a few soft masses of lime; moderately calcareous; pH 7.8; gradual, wavy boundary.

C1ca—17 to 26 inches, light yellowish-brown (2.5Y 6/3) light clay loam, light olive brown (2.5Y 5/3) when moist; weak, medium, blocky structure; hard when dry, friable when moist, sticky and plastic when wet; many spots of lime; strongly calcareous; pH 8.4; gradual boundary.

C2—26 to 37 inches, pale-olive (5Y 6/3) light clay loam, olive (5Y 5/3) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; a few spots of lime; strongly calcareous; pH 8.4; gradual boundary.

C3—37 to 60 inches, light-gray (5Y 7/2) clay loam, pale olive (5Y 6/3) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; moderately calcareous; pH 8.4.

In hue the Thurlow soils range from 2.5Y to 10YR in the A and B horizons and from 2.5Y to 5Y in the Cca and C horizons. Chroma is 2 or 3 in all horizons. Value is 6 or 7 when the C horizon is dry and is 5 or 6 when it is moist. Depth to the C1ca horizon is 10 to 16 inches.

Thurlow clay loam, 0 to 1 percent slopes (Ta).—This soil is on high terraces and fans in the river valleys and their larger tributary valleys. The profile is typical for the series. Surface gravel occurs along shallow drainageways that carry runoff water from gravel-capped uplands. Slopes are mainly ½ to 1 percent, and runoff is slow. There is some risk of erosion where runoff water from the larger valleys crosses the fans and terraces.

This soil is used for dry and irrigated farming and for range. Irrigated crops are sugar beets, dry beans, corn for silage, small grains, and hay. Small grains and hay are dryfarmed. (Capability unit I–1, irrigated; IIIc–1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Thurlow clay loam, 4 to 7 percent slopes (Tc).—This soil is on fans at the mouth of major drainageways that empty into the river valleys and on the sides of wide valleys in the uplands. The range of features in the profile is minimum for the series. Gravel is scattered through soils that lie below gravel-capped uplands, and as much as 25 percent of the surface of soils that lie along shallow drainageways may be covered with gravel and cobblestones. Slopes are mainly 5 percent. Slopes of 7 percent occur on the upland valleys. Runoff is medium, and the risk of water erosion is moderate. Included in mapping are McRae and Haverson soils along main drainageways and on steep parts of fans. These included soils make up 10 to 15 percent of any area mapped.

Most of this soil is used for dryfarming and for range. A small area in the Yellowstone River valley is irrigated by contour ditches to grow small grains, hay, and pasture crops. (Capability unit IIIe–2, irrigated; IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Toluca Series

The Toluca series consists of well-drained, nearly level to moderately steep, clay loam soils on the terraces of large stream valleys. These soils formed in clay loam alluvium and are more than 36 inches deep. The native vegetation is grasses and sagebrush. Elevation ranges from 3,000 to 3,500 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is 125 to 130 days. Toluca soils are associated with Keiser and Wanetta soils.

In a typical profile, the cultivated surface layer is grayish-brown clay loam 5 inches thick. It is a mixture of the original loam surface layer, which was 2 inches thick, and the upper 3 inches of the clay loam subsoil. The subsoil is brown to brownish-gray clay loam, 7 inches thick. The lower part is calcareous. The substratum is strongly calcareous light-gray loam. Very gravelly loam is at a depth of 35 inches. The gravel in the substratum is undercoated with lime.

Permeability is moderate, and the available water capacity is 7 to 9 inches. The organic-matter content and fertility are moderate.

These soils are suited to irrigated row crops, small grains, and hay, to dryfarmed small grains, and to range.

Typical profile of cultivated Toluca clay loam, 0 to 1 percent slopes, approximately 1,600 feet north and 45 feet east of the center of section 5, T. 4 N., R. 34 E.:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; cloddy; clods break to weak, fine, crumb structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; pH 7.3; abrupt, smooth boundary.

B2t—5 to 9 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, blocky; hard when dry, firm when moist, sticky and plastic when wet; peds are coated with moderately thick, continuous clay films; pH 7.3; clear, smooth boundary.

B3ca—9 to 12 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; weak, medium, prismatic structure that breaks to moderate, fine, blocky; hard when dry, firm when moist, sticky and plastic when wet; peds are coated with thin, patchy, clay films; common lime films and nodules; moderately calcareous; pH 7.8; gradual, wavy boundary.

C1ca—12 to 25 inches, light-gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) when moist; weak, coarse, blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; strongly calcareous; pH 8.4; diffuse boundary.

C2—25 to 35 inches, light-gray (5Y 7/2) loam, olive gray (5Y 5/2) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; strongly calcareous; pH 8.4; clear boundary.

IIC3—35 to 60 inches, very gravelly loam; about 60 to 70 percent gravel, by volume; strongly calcareous; pH 8.4.

The Toluca soils range from 10YR to 5Y in hue and from 2 to 4 in chroma. The B horizon is 30 to 35 percent clay. The combined thickness of the A and B2 horizons is 7 to 12 inches. The C horizon ranges in value from 6 to 7 when dry and from 5 to 6 when moist. Depth to the very gravelly IIC3 horizon is 35 to 48 inches. The Cca horizon is 15 to 25 percent calcium carbonate equivalent. Gravel is abundant on the surface of moderately steep soils but does not occur on level soils.

Toluca clay loam, 0 to 1 percent slopes (Te).—This soil occurs on smooth, broad terraces that lie along the Yellowstone River Valley. The terraces are unbroken by drainageways. The profile is typical for the series. Soils at higher elevation have some surface gravel. Slopes are mainly one-half percent, and runoff is slow. The risk of water erosion and soil blowing is low. Included in mapping are Wanetta soils on nearly level slopes.

This soil is used for dryfarmed wheat and barley, irrigated sugar beets, dry beans, corn for silage, small grains, and hay, and for range. (Capability unit I–1, irrigated; IIIc–1, dryland; Silty range site, 10- to 14-inch precipitation zone)

Toluca clay loam, 1 to 4 percent slopes (Th).—This soil occurs on the high terraces that lie along the Yellowstone and Bighorn River Valleys near Custer. The profile is similar to that typical for the series. The light-gray calcareous substratum is exposed in cultivated soils that are on top of knolls. Gravel occurs on the surface of steep soils that are along deep drainageways. Slopes are mainly 2 percent. Some 4-percent slopes occur along the deep drainageways. Runoff is medium, and the risk of water erosion is moderate. The risk of soil blowing is moderate where the calcareous substratum has been exposed by leveling or deep plowing. Included in mapping are Wanetta and Lambert soils.

This soil is used for dryfarmed wheat, barley, and hay, irrigated sugar beets, corn for silage, small grains, and hay, and for range. (Capability unit IIe–1, irrigated; IIIe–5, dryland; Silty range site, 10- to 14 inch precipitation zone)

Toluca clay loam, 4 to 7 percent slopes (Tm).—This soil occurs on fans, terrace edges, and deeply eroded terraces and along the margins between alluvial terraces and residual uplands. The profile is similar to the one typical for the series except that the thickness of the soil layers and the depth to lime are minimum. Plowing on narrow ridge crests and steep slopes exposes the light-gray calcareous substratum. Slopes are mainly 4 and 5 percent. Short slopes of 6 and 7 percent occur on breaks between terrace levels and on the sides of main drainageways. Runoff is medium, and the risk of water erosion on cultivated soil is moderate. The risk of soil blowing is moderate where the calcareous substratum is exposed by deep plowing.

The soil is used for irrigated small grains and hay, for dryfarmed wheat, hay, and barley, and for range. (Capability unit IIIe 2, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Toluca and Wanetta clay loams, 0 to 2 percent slopes (Tn).—This complex occurs on terraces and fans south and east of Laurel. The combined thickness of the surface layer and subsoil of Toluca soils is less than that of the Wanetta soils, and the Toluca soil is underlain by gravelly sand at a depth of 24 to 40 inches. The Toluca soil occupies slightly higher areas, and the Wanetta soils are in swales and on nearly level slopes. In some areas gravel occurs throughout both soils. Slopes are mainly ½ to 1 percent. Runoff is slow, and the risk of soil blowing and water erosion is low.

All these soils are irrigated to row crops, small grains, and hay. Deep cuts made in leveling may expose underlying gravel. (Capability unit IIs–3, irrigated)

Toluca and Wanetta clay loams, 2 to 4 percent slopes (To).—This complex occurs on fans and terraces east and southeast of Laurel. Many of the terraces are cut by old stream meanders and channel scars. The surface is uneven and is crossed by shallow drainageways. Each soil has a profile similar to that typical for its series except that the Toluca soil is underlain by gravelly sand at a depth of 28 to 48 inches. Deep plowing on the crests of ridges and mounds exposes the calcareous substratum of the Toluca soil. Slopes are mainly 2 percent. Surface runoff is medium, and the risk of water erosion is moderate. Irrigated soils on steeper slopes have been moderately eroded.

These soils are used for irrigated row crops, hay, and pasture. (Capability unit IIe–1, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Travessilla Series

The Travessilla series consists of somewhat excessively drained, sloping to moderately steep soils that formed in materials weathered from hard sandstone. The native vegetation is bluebunch wheatgrass, skunkbush sumac, ricegrass, yucca, sandreed, and ponderosa pine and cedar trees. Elevation ranges from 2,900 to 3,900 feet. The annual precipitation is 11 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost free season is about 125 days. These soils are associated with Worland, Apron, Bainville, and Elso soils.

In a typical profile, the surface layer is brown sandy loam 2 inches thick. The substratum is yellowish-brown fine sandy loam 10 inches thick. Depth to hard sandstone is 14 inches.

Permeability is moderate to rapid, and the available water capacity is 1 to 3 inches.

Travessilla soils are used for range.

Typical profile of Travessilla sandy loam, 4 to 15 percent slopes, approximately 1,000 feet north and 150 feet west of the SE. corner of section 29, T. 1 N., R. 26 E.:

A1—0 to 2 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; noncalcareous; pH 7.3; gradual, wavy boundary.

C1—2 to 10 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; noncalcareous; pH 7.3; gradual, wavy boundary.

C2—10 to 14 inches, partly weathered sandstone fragments undercoated with lime.

R 14 to 17 inches, hard sandstone.

The A and C horizons are generally sandy loam, but in some areas texture is loam and loamy sand.

All layers range from 10YR to 2.5Y in hue. In value the A horizon is 5 and 6 when dry and 3 and 4 when moist. Chroma in the C horizon ranges from 2 to 4. Depth to lime is 4 to 10 inches. Thin fragments of unweathered sandstone make up as

much as 25 percent of the soil, by volume. These fragments are scattered on the surface and throughout the profile. Depth to hard sandstone is 10 to 20 inches.

Travessilla sandy loam, 4 to 15 percent slopes (Tr).—This soil occurs on sandstone uplands north of the Yellowstone River Valley. It occupies ridges and the sides of drainageways cut through the thick sandstone escarpment which forms the rim of deep stream valleys. The areas form bands 300 to 1,000 feet wide that lie along and extend back from the valley rims. Rock crops out along the edge of deep drainageways. The profile is typical for the series. The gently sloping areas are deep and have few rock outcrops. Runoff is slow to medium. The risk of soil blowing is high. In soil-blown areas, sandstone crops out and low sand dunes occur on the east side.

This soil is used for range. (Capability unit VIe–3, dryland; Shallow Limy range site, 10- to 14-inch precipitation zone)

Travessilla loam, 4 to 7 percent slopes (Ts).—This soil occurs on smooth, bedrock plains made up of low ridges and knolls separated by broad, shallow drainageways. The largest acreage is in the northwestern part of the county. The profile is similar to the one described as typical for the series except that the substratum is very limy below a depth of 12 inches. Rock ledges 1 to 2 feet high and very stony areas occur along the edges of deep valleys. Slopes are mainly 4 percent, and runoff is slow. The risk of soil blowing is moderate to low. Included in mapping are Bainville, Cushman, and Worland soils.

This soil is used for range. (Capability unit VIe–3, dryland; Shallow Limy range site, 10- to 14-inch precipitation zone)

Travessilla loam, 7 to 15 percent slopes (Tt)—This soil is on rolling uplands underlain by hard sandstone 5 to 25 feet thick. The sandstone crops out as single escarpments along deep drainageways or as ledges that separate smooth uplands from steep, deeply dissected soils. Except for the loam surface texture, the profile is similar to that typical for the series. Travessilla fine sandy loam soil and shale and rock outcrops occur along the sandstone ledges or on the rims of deep drainageways. Some rock ledges are very steep. Runoff is medium, and the risk of water erosion is moderate.

This soil is used only for range. (Capability unit VIe–3, dryland; Shallow Limy range site, 10- to 14-inch precipitation zone)

Treasure Series

The Treasure series consists of deep, well-drained, gently sloping to sloping alluvial soils that formed in material weathered from sandstone. The soils are on fans and terraces in the river valleys and on foot slopes below sandstone ledges that crop out on the valley sides. Elevation ranges from 2,900 to 3,400 feet. The native vegetation is needle-and-thread, western wheatgrass, yucca, prairie junegrass, and big sagebrush. Annual precipitation is 12 to 13 inches, the mean annual temperature is 45° F., and the frost-free season is 125 days. Treasure soils are associated with McRae, Fort Collins, and Thurlow soils.

In a typical profile, the surface layer is brown fine sandy loam 5 inches thick. The subsoil is yellowish-brown sandy clay loam about 11 inches thick. The substratum is olive-brown, calcareous sandy loam several feet thick.

Permeability is moderate, and the available water capacity is 8 to 10 inches. The risk of soil blowing and water erosion is moderate, and the fertility is moderate.

Treasure soils are used for dry and irrigated farming and for range.

Typical profile of Treasure fine sandy loam, 1 to 4 percent slopes, 500 feet north of the center of the SW¼, section 19, T. 1 N., R. 25 E.:

A1—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.3; clear, wavy boundary.

B21t—5 to 10 inches, dark yellowish-brown (10YR 4/4) light sandy clay loam, dark yellowish brown (10YR 3/4) when moist; moderate, medium, prismatic structure that breaks to weak, coarse, blocky; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; moderately thick clay films bridge the sand grains; noncalcareous; pH 7.3; gradual, wavy boundary.

B22t—10 to 16 inches, yellowish-brown (10YR 5/4) sandy clay loam, dark brown (10YR 4/3) when moist; moderate, medium and fine, prismatic structure that breaks to moderate, medium, blocky; moderately thick clay films bridge the sand grains; noncalcareous; pH 7.3; clear, wavy boundary.

C1ca—16 to 20 inches, light olive-brown (2.5Y 5/3) light sandy loam, olive brown (2.5Y 4/4) when moist; massive; hard when dry, friable when moist, slightly plastic when wet; strongly calcareous; pH 8.4; gradual, wavy boundary.

C2—20 to 38 inches, light-gray (2.5Y 7/2) sandy loam, light yellowish brown (2.5Y 6/3) when moist; massive; slightly hard when dry, friable when moist; very strongly calcareous; pH 8.4; gradual boundary.

C3—38 to 60 inches, light-gray (2.5Y 7/2) stratified sandy loam and loam; very strongly calcareous; pH 8.4.

The B horizon is 8 to 15 inches thick. Chroma in the B and C horizons range from 2 to 4. Depth to the Cca horizon is 12 to 18 inches. The lower part of the C horizon in places contains thin strata of loam.

Treasure fine sandy loam, 1 to 4 percent slopes (Tu).—This soil occurs on fans at the mouth of tributary drainageways that empty into the Yellowstone River Valley and on terraces along the east side of Clarks Fork. The soil on high terraces along Clarks Fork formed in coarse sands that washed from older terraces and were mixed with material blown from the river valley. To the west of Billings the soil occurs on footslopes below the high sandstone rimrock. Slopes are mainly 1 to 3 percent. Slopes are stronger on terraces crossed by deep drainageways. Surface runoff is slow. Included in mapping is a narrow band of sloping Glenberg soil below the sandstone rimrock.

This soil is used for dry and irrigated farming and for range. Small grains and alfalfa are dryfarmed. Irrigated crops are sugar beets, dry beans, corn for silage, alfalfa, and hay. (Capability unit IIe–1, irrigated; capability unit IIIe–7, dryland; Sandy range site, 10- to 14-inch precipitation zone)

Treasure fine sandy loam, 4 to 10 percent slopes (Tw).—This soil occurs on eroded fans and below the sandstone rimrocks of intermittent-stream valleys. Except for stronger slopes, the profile is similar to that described as typical for the series. The surface layer of soils on sharp ridges has been eroded by soil blowing, and light-gray

spots of eroded soil occur on cultivated fields. Slopes are short and mainly 4 to 7 percent. Slopes of 8 to 10 percent occur on the upper sides of the valleys just below the base of the sandstone outcrop. The risk of soil blowing is high on bare soils, and the risk of water erosion is moderate to high on irrigated soils. Included in mapping are patches of Apron soil, ½ to 2 acres in size, at the base of sandstone rimrocks in valleys or on the sides of deep drainageways that cross the fans.

This soil is used mostly for dryfarmed wheat, barley, and alfalfa and for range. A few areas are irrigated. (Capability unit IIIe-2, irrigated; IIIe-7, dryland; Sandy range site, 10- to 14-inch precipitation zone)

Vananda Series

The Vananda series consists of well-drained, nearly level to sloping, clayey soils on fans and flood plains and on lake basins near rivers and intermittent streams. The native vegetation is mainly western wheatgrass and greasewood. Elevation ranges from 3,000 to 3,700 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost free season is 120 to 125 days. These soils are associated with Kyle and Bone soils.

In a typical profile, the surface layer is light olive-gray silty clay 3 inches thick. The subsoil is olive-gray to pale-olive heavy clay 14 inches thick. The substratum is pale olive clay to pale-yellow clay loam several feet thick. The soil is strongly alkaline, and the substratum contains threads and spots of crystalline gypsum and other salts.

Permeability is very slow, and the available water capacity is 8 to 10 inches.

Vananda soils are used for irrigated small grains, corn for silage, and hay and pasture, and for range.

Typical profile of Vananda silty clay, 0 to 1 percent slopes, 100 feet west of the E¼ corner of section 31, T. 3 N., R. 24 E.:

A1—0 to 3 inches, light olive-gray (5Y 6/2) silty clay, olive gray (5Y 5/2) when moist; strong, very fine, granular structure beneath a thin, massive, vesicular surface crust; hard when dry, firm when moist, sticky and plastic when wet; weakly calcareous; pH 8.2; clear boundary.

B21—3 to 7 inches, light olive-gray (5Y 6/2) heavy clay, olive gray (5Y 5/2) when moist; moderate, medium, prismatic structure that breaks to weak, very fine, blocky; very hard when dry, very firm when moist, sticky and very plastic when wet; weakly calcareous; pH 8.8; gradual boundary.

B22—7 to 17 inches, pale-olive (5Y 6/3) heavy clay, olive (5Y 5/3) when moist; moderate, coarse, prismatic structure; very hard when dry, very firm when moist, sticky and very plastic when wet; strongly calcareous; pH 8.9; clear, wavy boundary.

C1cs—17 to 30 inches, pale-olive (5Y 6/4) heavy clay, olive (5Y 5/3) when moist; massive; very hard when dry, very firm when moist, sticky and very plastic when wet; common seams and nests of gypsum and other salts and a few threads of lime; very strongly calcareous; pH 9.2; gradual, wavy boundary.

C2cs—30 to 55 inches, light olive-gray (5Y 6/2) light clay, olive gray (5Y 5/2) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; a few seams and nests of gypsum and other salts; very strongly calcareous; pH 9.1; clear boundary.

C3—55 to 62 inches, pale-yellow (5Y 7/3) light clay loam, pale olive (5Y 6/3) when moist; massive; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; very strongly calcareous; pH 9.1.

The Vananda soils range from 2.5Y to 5Y in hue. In value the A horizon is 5 or 6 when dry and 4 or 5 when moist. The B and C horizons have value of 6 or 7 when dry and 5 or 6 when moist. Chroma in the C horizons ranges from 2 to 4. In cultivated fields the Ap horizon is cloddy, slakes when wet, and forms a crust on the surface when dry. Depth to gypsum and salt is 12 to 15 inches. In the lower part of the C horizon, soils at the outer margin of lake basins may have strata of loam and fine sandy loam.

The pH ranges from 7.9 to 8.4 in the A horizon, 8.5 to 9.0 in the B horizons, and 8.5 to 9.5 in the C horizons.

Vananda silty clay, 0 to 1 percent slopes (Va).—This soil is on stream terraces and dry lake basins in the northern half of the county. The mapped areas range from 5 to 250 acres in size. The profile is typical for the series. On broad river terraces the soil is underlain by stream deposited gravel at a depth of 60 inches. Runoff is very slow, and the risk of erosion is low. Included with this soil in mapping are McKenzie soils on lake basins and Bone soils on river terraces.

This soil is used for irrigated corn for silage, small grains, and hay and pasture, and for range. (Capability unit IVs–1, irrigated; VIs 1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Vananda silty clay, 1 to 7 percent slopes (Vd).—This soil occurs on stream terraces, fans, and lake basins. The profile is similar to the one described as typical for the series. Slopes are mainly 1 to 3 percent on the terraces and lakebeds and 4 to 7 percent on the fans. Runoff is slow to rapid, and the risk of water erosion is slight to moderate. Included in mapping are Bone soils on the fans and terraces.

This soil is used for range. (Capability unit VIs 1, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Vananda-Bone clays, 4 to 7 percent slopes (Ve).—These soils are on fans and on the bottom of narrow, intermittent-stream valleys south of the Yellowstone River Valley. The unit is 45 to 65 percent Vananda soil and 25 to 60 percent Bone soil. The Bone soil has a light-gray, glazed surface and is nearly barren. The Vananda soil has a good cover of western wheatgrass, annual weeds, and greasewood. The profile of each soil is similar to the one described as typical for its series except that raw and partly weathered shale fragments occur in all layers of both soils. Slopes are short, and runoff is medium to rapid. Pits occur in the surface of eroded Bone soils. Included in mapping are spots of Arvada soil that make up about 15 percent of the mapped areas.

These soils are used only for range. (Vananda clay is in capability unit VIs–1, dryland; Clayey range site, 10- to 14-inch precipitation zone; Bone clay is in capability unit VIIs–2, dryland; Saline Upland range site, 10- to 14 inch precipitation zone)

Wanetta Series

The Wanetta series consists of well-drained, nearly level to sloping, clay loam soils on terraces of large stream valleys. The soils formed in alluvium and are 20 to 40 inches deep over sand and gravel. The native

vegetation is grasses and sagebrush. Elevation ranges from 3,000 to 3,400 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 128 days. Wanetta soils are associated with Larim and Toluca soils.

In a typical profile, the cultivated surface layer is grayish-brown clay loam 8 inches thick. It is a mixture of the original loam surface layer that is 3 inches thick and the upper 3 to 5 inches of subsoil. The subsoil is brown clay loam about 9 inches thick. The substratum is light brownish-gray gravelly light clay loam that contains light-gray threads and mottles of lime. Depth to loose, very gravelly sand is 26 inches (fig. 6).

Permeability is moderate, and the available water capacity is 5 to 7 inches. The organic-matter content and fertility are moderate, and the root zone is moderately deep.

These soils are used for irrigated row crops, small grains, hay and pasture, and dryfarmed small grains, and for range.

Typical profile of Wanetta clay loam, 1 to 4 percent slopes, in a roadbank, 660 feet north of the W¼ corner of section 14, T. 1 S., R. 25 E.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium and fine, granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.8; abrupt boundary.

B2t—8 to 13 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, firm when moist, sticky and plastic when wet; moderately thick, patchy clay films on ped faces; some gravel thinly coated with lime; pH 8.4; gradual boundary.

B3ca—13 to 17 inches, light brownish-gray (2.5Y 6/2) light clay loam, grayish brown (2.5Y 5/2) when moist; weak, medium, prismatic structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; some gravel; common nodules and seams of lime; strongly calcareous; pH 8.4; gradual boundary.

C1ca—17 to 26 inches, light brownish-gray (2.5Y 6/2) gravelly light clay loam, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; 35 percent gravel, by volume; many seams of lime; strongly calcareous; pH 8.4; gradual, wavy boundary.

IIC2—26 to 60 inches, loose sand and gravel; 65 percent gravel, by volume.

The Wanetta soils range from 10YR to 2.5Y in hue and from 2 to 4 in chroma. The A horizon is loam to light clay loam 2 to 8 inches thick. It is thickest in nearly level, gravel-free soils. The B2t horizon is 5 to 12 inches thick and 27 to 35 percent clay. Depth to the Cca horizon is 10 to 25 inches. Gravel content is 0 to 30 percent in all horizons. As much as 40 percent of the surface of the gravelly soils is covered with pebbles and cobblestones 1 to 5 inches in diameter.

***Figure 6.*—Profile of a Wanetta clay loam showing the loose, very gravelly sand substrata.**

Wanetta loam, 0 to 1 percent slopes (Wa). This soil is on smooth terraces and fans in the Yellowstone River Valley and on bordering uplands. The areas are small and occur beside more sloping Wanetta soils. The soil has a profile similar to the one typical for the series except that it has a loam surface layer and is gravel-free to a depth of 24 inches. The surface layer is more than 6 inches thick in areas where runoff water collects. Depth to very gravelly sand is more than 30 inches. Slopes are mainly one-half percent. Runoff is very slow, and the risk of erosion is slight. Included with this soil in mapping are Bew soils in swales and on level slopes. Bew soils make up about 10 percent of the areas mapped.

This soil is used for irrigated sugar beets, corn for silage, dry beans, small grains, and hay, and for dryfarmed wheat and barley. Small areas are used for range. (Capability unit IIs-3, irrigated; IIIe-5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Wanetta loam, 1 to 4 percent slopes (Wc).—This soil occupies areas 10 to 30 acres in size on high terraces and fans between Ballantine and Pompeys Pillar. The profile is typical for the series except that the surface layer is loam 6 inches thick, and the depth to very gravelly sand is 30 to 40 inches. Slopes are short, uneven, and mainly 1 to 2 percent. Short slopes of 3 to 4 percent occur where fan edges merge with stream terraces or on the breaks between terrace levels. Runoff is slow, and the risk of erosion is slight.

This soil is used for irrigated sugar beets, corn for silage, small grains and hay, and for range. Small grains are dryfarmed in a few areas. Irrigation water must be applied carefully to prevent erosion. (Capability unit IIe–1, irrigated, IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Wanetta gravelly loam, 0 to 2 percent slopes (We).—This soil occurs in areas 2 to 25 acres in size on the terraces of the Yellowstone River near Laurel and east of Ballantine. The surface is generally smooth and unbroken by drainageways. The profile is similar to the one described as typical for the series except that all layers contain the maximum amount of gravel. As much as 40 percent of the surface of cultivated fields is covered by gravel and cobblestones. The gravel is not uniformly distributed over the surface, but is concentrated on the crests of low ridges and mounds and along shallow drainageways. Runoff is slow, and the risk of erosion is slight. Slopes are about 75 feet long and dominantly 1 to 2 percent. Short, uneven, 4-percent slopes occur where shallow drainageways cross the terraces.

This soil is used mostly for irrigated hay and pasture. Surface gravel and cobblestones and the uneven slopes make irrigation difficult. Waste water has caused seeped spots and a high water table to form in some areas of this soil. (Capability unit IIs–3, irrigated; IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Wanetta clay loam, 0 to 1 percent slopes (Wf).—This soil is on high terraces in the Yellowstone River Valley and on bordering uplands. The profile is similar to the one described as typical for the series. The surface layer is 4 inches thick in areas where runoff water collects. Some gravel occurs at depths of more than 10 inches. Included in mapping are Bew soils in swales and in areas where runoff water collects. Bew soils make up about 10 percent of the areas mapped. Also included are spots of Larim soil.

This soil is used for irrigated sugar beets, dry beans, corn for silage, hay, small grains, and pasture and dryfarmed wheat and barley. Small areas outside the river valley are used for grazing beef cattle. (Capability unit IIs–3, irrigated; IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Wanetta clay loam, 1 to 4 percent slopes (Wg).—This soil occurs on parts of stream terraces marked by old meanders and on terrace edges and short breaks that separate terrace levels. The surface is uneven, and drainageways are not well established on most of the terraces. Gravel occurs on the surface in the more sloping areas. Slopes are mainly 2 percent and 50 to 100 feet long. Shorter and steeper slopes occur on terrace edges and breaks between terrace levels and in the deepest drainageways. The profile of this soil is the one described as typical for the Wanetta series.

This soil is used for irrigated sugar beets, dry beans, corn for silage, small grains, and hay, for dryfarmed wheat and barley, and for range. (Capability unit IIe–1, irrigated; IIIe–5, dryland; Clayey range site, 10- to 14-inch precipitation zone)

Wanetta-Larim clay loams, 0 to 1 percent slopes (Wh).—This complex occurs on smooth terraces in the Yellowstone River Valley and on the bordering gravel-capped uplands. Shallow swales and indistinct drainageways are cut 1 to 3 feet below the surface. About 70 percent is Wanetta clay loam and 30 percent is Larim clay loam. Each soil has a profile similar to the one typical for its series except that the Larim soil has a clay loam surface layer. The Wanetta soils are in swales and level areas. The Larim soils are on gravel-covered low ridges and mounds where slope is 1 percent. About 15 percent of the surface of cultivated Larim soils is covered with gravel. Runoff is slow, and there is no risk of erosion.

These soils are used for dryfarmed and irrigated small grains, hay, and pasture and for range. (Capability unit IIIs–2, irrigated; IIIe–5, dryland; Wanetta soil is in Silty range site, 10- to 14-inch precipitation zone; Larim soil is in Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Wanetta-Larim clay loams, 1 to 4 percent (Wk).—This complex occurs on well-drained terraces south of Laurel and east of Ballantine. About 70 percent is Wanetta clay loam, 25 percent is Larim clay loam, and 5 percent is Larim gravelly loam. Each soil has a profile similar to the one typical for its series except that the Larim soil has a clay loam surface layer. Depth to underlying sand and gravel varies. The Wanetta soils are in shallow swales and have slopes of 1 and 2 percent. The Larim loam soils are on low ridges and mounds and sides of drainageways that have slopes of 3 and 4 percent. Larim gravelly loam is on ridges, mounds, and terrace edges where drainageways are narrow and deep. Gravel is common on the surface of this soil. Slopes are short and uneven. Runoff is slow to medium, and the risk of erosion is slight to moderate.

This complex is used for irrigated and dryfarmed small grains, for hay and pasture, and for range. (Capability unit IIIs–2, irrigated; IIIe–5, dryland; Wanetta soil is in Silty range site, 10- to 14-inch precipitation zone; Larim soil is in Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Wanetta-Larim clay loams, 4 to 7 percent slopes (Wl).—This complex occurs on high terraces in the Yellowstone River Valley and on bordering gravel-capped uplands. It occupies a narrow band along terrace edges and breaks between terrace levels. Drainageways are narrow and 3 to 5 feet deep. Slopes are short and uneven. Each soil has a profile typical for its series except that the Larim soil has a clay loam surface layer. About 60 percent is Wanetta clay loam and 40 percent is Larim clay loam. The Wanetta soils are on smooth mounds and low ridges between shallow drainageways. Slopes are mainly 4 and 5 percent. The Larim soils are on sharp ridges and mounds and on areas cut by deep, closely spaced drainageways. The amount of surface gravel on Larim soils varies.

Slopes are short and mainly 6 and 7 percent. Runoff is medium and the risk of erosion is moderate.

This complex is used for irrigated and dryfarmed hay and pasture and for range. (Capability unit IVe-1, irrigated; IIIe-5, dryland; Wanetta soil is in Silty range site, 10- to 14-inch precipitation zone; Larim soil is in Shallow to Gravel range site, 10- to 14-inch precipitation zone)

Work Series

The Work series consists of well-drained, gently sloping to sloping soils on small fans and in narrow drainageways. These soils formed in mixed alluvium that washed from steep terrace edges. They are more than 60 inches deep. The native vegetation is mainly sagebrush, needle-and-thread, broom snakeweed, prairie junegrass, and bluegrass. Elevation is about 3,500 feet. The annual precipitation is 14 to 16 inches, the mean annual temperature is 44° F., and the frost-free season is 120 to 125 days.

In a typical profile, the surface layer is light brownish-gray clay loam and loam 4 inches thick. The subsoil is brown clay and clay loam 23 inches thick. The lower part of the subsoil contains some light-gray threads of lime. The substratum is calcareous clay loam and loam several feet thick.

Permeability is moderately slow, and the available water capacity is 9 to 11 inches. The organic-matter content and fertility are moderate to high.

Soils of the Work series are used for dryfarming and for range.

Typical profile of Work clay loam, 1 to 4 percent slopes, 400 feet east and 275 feet north of W¼ corner of section 14, T. 1 N., R. 29 E.:

A11—0 to 2 inches, light brownish-gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure that breaks to weak, fine, crumb; soft when dry, friable when moist, nonsticky and nonplastic when wet; pH 7.3; clear, smooth boundary.

A12—2 to 4 inches, light brownish-gray (10YR 6/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; pH 7.3; clear, smooth boundary.

B1—4 to 6½ inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 2/2) when moist; moderate, medium, platy structure; slightly hard when dry, friable when moist, sticky and plastic when wet; thin, patchy clay films on ped faces; pH 7.3; clear, smooth boundary.

B21t—6½ to 11 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/4) when moist; strong, medium, prismatic structure that breaks to strong, fine, blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; moderately thick, continuous clay films on ped faces; pH 7.8; gradual, wavy boundary.

B22t—11 to 17 inches, brown (10YR 5/3) clay, dark brown (10YR 3/4) when moist; strong, fine, prismatic structure that breaks to strong, fine, blocky; very hard when dry, firm when moist, very sticky and very plastic when wet; moderately thick, continuous clay films on ped faces; pH 7.8; gradual, wavy boundary.

B23t—17 to 21 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure that breaks to moderate, medium, blocky; very hard when dry, firm when moist, sticky and very plastic when wet; moderately thick, continuous clay films and patches of thick coatings on ped faces; pH 7.8; gradual, wavy boundary.

B3—21 to 27 inches, light yellowish-brown (2.5Y 6/3) clay loam, olive brown (2.5Y 4/3) when moist; moderate, medium, blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; thin, patchy clay films on ped faces; a few threads of lime; moderately calcareous; pH 8.4; clear, wavy boundary.

C1ca—27 to 34 inches, light-gray (2.5Y 7/2) clay loam, light olive brown (2.5Y 5/3) when moist; weak, coarse, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common seams and nodules of lime; strongly calcareous; pH 8.4; gradual, wavy boundary.

C2—34 to 41 inches, light yellowish-brown (2.5Y 6/3) clay loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, friable when moist, sticky and plastic when wet; common seams and nodules of lime; strongly calcareous; pH 8.4; clear, wavy boundary.

C3—41 to 61 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; massive; hard when dry, firm when moist, sticky and plastic when wet; a few nodules of lime; moderately calcareous; pH 8.4.

Work soils range from 10YR to 2.5Y in hue and are 5 or 6 in value. In cultivated fields the Ap horizon is 25 to 30 percent clay. The B horizon is 15 to 25 inches thick and 35 to 45 percent clay. This horizon ranges from 10YR to 2.5Y in hue and has value of 4 or 5 and chroma of 3 or 4. When the lower part of the Bt horizon is dry, it has value of 5 or 6, hue of 2.5Y, and chroma of 3 or 4. In the Cca and C horizons, value ranges from 5 to 7 and lime threads and mottles have value of 8 and chroma of 1 or 2. Sandy loam strata containing round pebbles occur in places below a depth of more than 30 inches. All horizons may contain gravel.

Work clay loam, 1 to 4 percent slopes (Wm).—This soil occurs on fans and narrow valleys on the high terraces south of Ballantine. The areas range from 5 to 10 acres in size. This soil has the thickest layers and the greatest amount of clay in the subsoil for the series. Slopes are mainly 3 percent and less than 300 feet long. Runoff is medium. The risk of water erosion is moderate on soils at the mouth of drainageways that empty into the larger valleys.

This soil is used for dryfarmed wheat, oats, barley, and alfalfa and for range. (Capability unit IIe-2, dryland; Silty range site, 15- to 19-inch precipitation zone)

Work clay loam, 4 to 7 percent slopes (Wn).—This soil is on fans and valley sides at the headwaters of Spring and Arrow Creeks south of Ballantine. This soil has the thinnest layers and least amount of clay for the series. It has more surface gravel and a wider range of texture in the substratum than does Work clay loam, 1 to 4 percent slopes. Slopes are mainly 4 percent and 250 feet long. Runoff is medium. The risk of water erosion on cultivated soil is moderate.

This soil is used for dryfarmed hay and pasture and for range. (Capability unit IIIe-4, dryland; Silty range site, 15- to 19-inch precipitation zone)

Worland Series

The Worland series consists of moderately deep, well-drained to somewhat excessively drained, sloping to moderately steep soils that formed in materials weathered from underlying sandstone. The native vegetation is

mainly ricegrass, needle-and-thread, yucca, sagebrush, sand reedgrass, and dryland sedges. Elevation ranges from 3,000 to 3,900 feet. The annual precipitation is 11 to 13 inches, the mean annual temperature is about 50° F., and the frost-free season is about 125 days. Worland soils are associated with Apron, Travessilla, and Bainville soils.

In a typical profile, the cultivated surface layer is light yellowish-brown fine sandy loam 4 inches thick. The substratum is light yellowish-brown and pale-yellow fine sandy loam and very gravelly sandy loam. Depth to unweathered sandstone is 40 inches.

Permeability is moderately rapid, and the available water capacity is 3 to 6 inches. The risk of soil blowing is moderate to high. The organic-matter content is low, and the fertility is moderate.

Worland soils are used for dryfarming and for range. Soil blowing has occurred on most dryfarmed soils, and soils in the drier parts of the county are no longer cultivated.

Typical profile of cultivated Worland fine sandy loam, 2 to 7 percent slopes, about 115 feet north and 180 feet east of the SW. corner of section 36, T. 2 N., R. 27 E.:

Ap—0 to 4 inches, light yellowish-brown (2.5Y 6/3) fine sandy loam, olive brown (2.5Y 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; strongly calcareous; pH 8.4; clear boundary.

AC—4 to 9 inches, light olive-brown (2.5Y 5/3) fine sandy loam, olive brown (2.5Y 4/3) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; weakly calcareous; pH 8.4; gradual boundary.

C1—9 to 22 inches, light yellowish-brown (2.5Y 6/3) fine sandy loam, light olive brown (2.5Y 5/3) when moist; very weak, coarse, prismatic structure; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; strongly calcareous; pH 8.4; clear, wavy boundary.

C2—22 to 30 inches, pale-yellow (2.5Y 7/3) fine sandy loam, light yellowish brown (2.5Y 6/4) when moist; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; a few, flat, unweathered sandstone fragments; lime nodules; strongly calcareous; pH 8.4; gradual boundary.

C3—30 to 40 inches, pale-yellow (2.5Y 7/3) very gravelly sandy loam, light yellowish brown (2.5Y 6/4) when moist; 70 percent, by volume, is strongly weathered sandstone fragments 1/4 to 1/2 inch thick; strongly calcareous; pH 8.4.

R—40 to 72 inches, unweathered and partly weathered sandstone.

Worland soils are generally calcareous at the surface, but the more nearly level soils may be leached to a depth of 4 or 5 inches. The A and C horizons range from fine sandy loam to loamy very fine sand. Depth to bedrock is 20 to 40 inches. Fragments of sandstone may make up 0 to 30 percent, by volume, of any layer. The amount of these fragments usually increases with depth.

Worland fine sandy loam, 2 to 7 percent slopes (Wo).—This soil is on smooth sandstone uplands north of the Yellowstone River. It occupies broad ridges and hills between the deep valleys of intermittent streams. Drainageways are broad, shallow, well grassed, and widely spaced. The profile is typical for the series. Slopes are short and dominantly 3 to 7 percent. Runoff is slow. The risk of soil blowing is high, and much of the cultivated soil has been eroded. The soils on crests of ridges and knolls are less than 20 inches deep and are covered with thin sandstone fragments. Sandstone crops out on the stronger slopes. Included in mapping are areas of Bainville and Travessilla soils.

This soil is used for dryfarmed small grains and for range. (Capability unit IVe–2, dryland; Sandy range site, 10- to 14-inch precipitation zone)

Worland-Travessilla fine sandy loams, 7 to 15 percent slopes (Wr).—This complex occurs in drainageways cut through thick sandstone bedrock in the northern half of the county. About 70 percent is Worland fine sandy loam, and 30 percent is Travessilla fine sandy loam. The Worland soils are on smooth ridges and hills and on the sides of shallow drainageways. Travessilla soils are on short, steep slopes and narrow ridges that are covered with rock fragments. Each soil has a profile similar to that described as typical for its series except that Worland soils are 20 to 24 inches deep and the Travessilla soils are 6 to 10 inches deep over bedrock. Runoff is medium on the Travessilla soils and slow on the Worland soils. Slopes are dominantly 9 percent. The risk of soil blowing is moderate to high. Included in mapping are small, barren sandstone outcrops and ledges.

These soils are used for range. (Capability unit VIe-1, dryland; Worland soil is in Sandy range site, 10- to 14-inch precipitation zone; Travessilla soil is in Shallow Limy range site, 10- to 14-inch precipitation zone)

Wormser Series

The Wormser series consists of well-drained, moderately deep, gently sloping to sloping soils that formed in weathered shale and sandstone on smooth undulating uplands in the northwestern part of the county. The native vegetation is mainly western wheatgrass, green needlegrass, needle-and-thread, prairie junegrass, and sagebrush. Elevation ranges from 3,200 to 3,900 feet. The annual precipitation is 12 to 14 inches, the mean annual temperature is 45 to 47° F., and the frost-free season is about 120 days. The Wormser soils are associated with Lavina, Razor, Ryegate, and Travessilla soils.

In a typical profile, the surface layer is grayish-brown loam 3 inches thick. The subsoil is grayish-brown and yellowish-brown clay loam and clay. The lower part of the subsoil is calcareous. The substratum is pale-yellow, calcareous gritty clay loam that contains light-gray threads and mottles of lime. Depth to shale and sandstone is 34 inches.

Permeability is moderately slow, and the available water capacity is 4 to 6 inches. The risk of soil blowing and water erosion is moderate to low. The organic-matter content is moderate, and the fertility is high.

These soils are used for dryfarming and for range.

Typical profile of Wormser clay loam, 4 to 7 percent slopes, 600 feet east and 400 feet north of the SW. corner, section 7, T. 4 N., R. 23 E.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure; soft when dry, friable when moist, nonsticky and slightly plastic when wet; pH 7.3; clear boundary.

B1—3 to 5 inches, dark grayish-brown (10YR 4/2) clay loam, dark brown (10YR 3/3) when moist; strong, medium, prismatic structure that breaks to weak, fine

and medium, blocky; slightly hard when dry, friable when moist, slightly sticky and plastic when wet: pH 7.3; clear boundary.

B2t—5 to 16 inches, yellowish-brown (10YR 5/4) light clay, dark yellowish brown (10YR 4/4) when moist; moderate, fine and medium, prismatic structure that breaks to strong, fine, blocky; very hard when dry, very firm when moist, sticky and very plastic when wet; patchy clay films on ped faces; pH 7.3; gradual boundary.

B3ca—16 to 20 inches, light yellowish-brown (2.5Y 6/3) gritty heavy clay loam, light olive brown (2.5Y 5/4) when moist; moderate, coarse, prismatic structure that breaks to moderate, coarse, blocky; very hard when dry, firm when moist, sticky and very plastic when wet; common fine threads and masses of lime; moderately calcareous; pH 7.8; gradual boundary.

Cca—20 to 34 inches, pale-yellow (2.5Y 7/3) gritty clay loam, light yellowish brown (2.5Y 6/4) when moist; massive; common threads and masses of lime; strongly calcareous; pH 8.4; gradual boundary.

R—34 inches, hard sandstone and shale.

In cultivated fields the Ap horizon is clay loam. The Wormser soils range from 10YR to 2.5Y in hue. Soils formed from shale have the yellowest hue. The B horizon is 7 to 17 inches thick and is 35 to 45 percent clay. Depth to bedrock ranges from 20 to 40 inches.

Wormser clay loam, 1 to 4 percent slopes (Ws).—This soil is on smooth uplands crossed by small drainageways. The profile is similar to the one described as typical for the series. Soils in the southeastern part of the county are less sandy and have a subsoil less than 7 inches thick. Slopes are mainly 1 to 2 percent. Slopes of 3 and 4 percent occur along the sides of high knolls and deep drainageways. Runoff is slow, and most precipitation enters the soil on gentle slopes. Included in mapping are Lavina, Travessilla, and Hydro soils.

This soil is used for dryfarmed wheat and barley and for range. (Capability unit IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Wormser clay loam, 4 to 7 percent slopes (Wt).—This soil occurs on undulating shale and sandstone uplands west and south of Acton. It occurs on the smooth, rounded ridges and divides between major valleys. Slopes are 4 and 5 percent on the crests of the wide ridges and in the shallow drainageways. Slopes are 6 and 7 percent on the narrow ridges and deep drainageways. The profile is typical for the series, but the surface layer of soils in swales is light brownish-gray and the subsoil contains more than 45 percent clay. Runoff is medium, and the risk of water erosion is moderate. Included in mapping are spots of Midway soils on ridges between the deeper drainageways.

This soil is used for dryfarmed wheat and barley and for range. (Capability unit IIIe–5, dryland; Silty range site, 10- to 14-inch precipitation zone)

Wormser-Lavina clay loams, 2 to 4 percent slopes (Wv).—This complex occurs north and west of Billings and Laurel on plains that are underlain by sandstone. About 75 percent is Wormser clay loam and 25 percent is Lavina clay loam. The Lavina soil is on the high ridge crests that are covered with flat sandstone fragments or it occurs in a band around rock outcrops. The Wormser soil has a thinner surface layer and subsoil and the substratum contains less lime than is typical for its series. The Lavina soil contains more clay than is typical for its series. Slopes are dominantly 2 percent, and runoff is slow. Included in mapping are spots where rock crops out.

These soils are used for dryfarmed wheat and barley and for range. (Capability unit IIIe–5, dryland; Wormser soil is in Silty range site, 10- to 14-inch precipitation zone; Lavina soil is in Shallow Limy range site, 10- to 14-inch precipitation zone)

Wormser-Worland sandy loams, 4 to 7 percent slopes (Ww).—This complex occurs west of Broadview. About 60 percent is Wormser sandy loam and 40 percent is Worland sandy loam. The Worland soils are on ridges and knolls. The Wormser soils are on the east slopes of ridges and in the troughs between the ridges. The Wormser soil has less clay in the subsoil and more sand in all layers than is typical for its series. Some soils have a loamy fine sand texture in all layers. Runoff is slow. The risk of soil blowing is high on the Worland soil. Included in mapping are Travessilla, Bainville, and Midway soils.

These soils are used for dryfarmed small grains and for range. (Capability unit IIIe–7, dryland; Sandy range site, 10- to 14-inch precipitation zone)

Yegen Series

The Yegen series consists of deep, level to moderately steep, well-drained soils on smooth fans, terraces, and foot slopes below rock outcrops in small stream valleys. The soils developed in materials that weathered from sandstone or were washed from gravel terraces. The native vegetation is mainly sand reedgrass, western wheatgrass, needle-and-thread, and sagebrush. Annual precipitation is 13 to 15 inches, the mean annual temperature is 42 to 44° F., and the frost-free season is 115 to 125 days. Elevation ranges from 3,000 to 3,900 feet.

In a typical profile, the cultivated surface layer is dark grayish-brown light sandy loam 6 inches thick. The subsoil is brown sandy clay loam 17 inches thick. The substratum is pale-brown to pale-yellow calcareous sandy loam several feet thick.

Permeability is moderately slow, and the available water capacity is 7 to 9 inches.

These soils are used for dry and irrigated farming and for range.

Typical profile of cultivated Yegen sandy loam, 4 to 10 percent slopes, in a field about 800 feet south and 720 feet east of the NW. corner of section 19, T. 2 N., R. 29 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) light sandy loam, very dark grayish brown (10YR 3/2) when moist; massive; soft when dry, friable when moist, nonsticky and slightly plastic when wet; noncalcareous; pH 6.5; clear, smooth boundary.

B21t—6 to 13 inches, brown (10YR 5/3) heavy sandy clay loam, dark brown (10YR 4/3) when moist; moderate, medium and coarse, prismatic structure that breaks to weak, medium, blocky; hard when dry, firm when moist, sticky and plastic when wet; moderately thick, continuous clay films on ped faces; noncalcareous, pH 7.3; gradual, wavy boundary.

B22t—13 to 19 inches, pale-brown (10YR 6/3) heavy sandy clay loam, dark brown (10YR 4/3) when moist; moderate, medium and coarse, prismatic structure; hard when dry, firm when moist, sticky and plastic when wet; thin, patchy clay films on ped faces; noncalcareous; pH 7.3; gradual, wavy boundary.

B3—19 to 23 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; noncalcareous; pH 7.3; gradual, wavy boundary.

C1—23 to 28 inches, pale-brown (10YR 6/3) heavy sandy loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; pH 7.8; gradual, wavy boundary.

C2ca—28 to 34 inches, pale-yellow (2.5Y 7/3) heavy sandy loam, light olive brown (2.5Y 5/3) when moist; massive; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; moderately calcareous; common threads of lime; pH 8.4; gradual, wavy boundary.

C3—34 to 64 inches, pale-yellow (2.5Y 7/3) sandy loam, light olive brown (2.5Y 5/3) when moist; massive; soft when dry, very friable when moist; moderately calcareous; pH 8.4.

The A horizon is 4 to 8 inches thick. This horizon has value of 2 or 3 when moist and of 4 or 5 when dry. The B2t horizon is 13 to 24 inches thick. Depth to the Cca horizon is 12 to 28 inches. Below a depth of 48 inches the C horizon has lenses of sand and a few pebbles. A few light-gray threads of lime occur in the upper part of the C horizon.

Yegen sandy loam, 0 to 1 percent slopes (Ya).—This soil is on level parts of large fans and terraces on the south side of the Yellowstone River Valley east of Huntley. It has a thicker and darker surface layer than is typical for the series, and some of the level areas have a loam surface texture. Runoff is slow. The risk of soil blowing is moderate on dryfarmed soils and slight on irrigated soils.

This soil is used for irrigated sugar beets, dry beans, corn for silage, alfalfa and small grains and dryfarmed small grains and alfalfa. (Capability unit I–1, irrigated; IIIe–6, dryland; Sandy range site, 15 to 19-inch precipitation zone)

Yegen sandy loam, 1 to 4 percent slopes (Yd).—This soil occurs on fans and gently undulating parts of the high terraces near Huntley and Ballantine. The profile is similar to that described as typical for the series. Areas on knolls and low ridges or along the shallow drainageways contain gravel. Slopes are dominantly 2 percent and 150 to 300 feet long. The risk of soil blowing and water erosion is moderate.

This soil is used for dry and irrigated farming and for range. (Capability unit IIe–1 irrigated; IIIe–6, dryland; Sandy range site, 15- to 19-inch precipitation zone)

Yegen sandy loam, 4 to 10 percent slopes (Ye).—This soil occurs on slopes below sandstone ledges, on fans, and on moderately sloping, eroded terraces. The profile is typical for the series. Included in mapping on slopes of more than 8 percent are areas that have a sandy clay loam subsoil 10 inches thick. The surface layer of areas below sandstone ledges is generally covered by 2 to 4 inches of material eroded from the rock ledges. Slopes are mainly 8 percent below the sandstone ledges and 5 percent on the fans and terraces. Runoff is slow, and the risk of soil blowing is moderate to high on bare soil.

This soil is used for dry and irrigated farming and for range. (Capability unit IIIe–2, irrigated; IIIe–6, dryland; Sandy range site, 15- to 19-inch precipitation zone)

Yegen and Toluca soils, 7 to 15 percent slopes (Yt).—These soils occur on eroded fans and terraces between Pryor and Fly Creeks. The landscape is narrow ridges alternating with valleys 20 to 40 feet deep. The surface is very uneven and covered with gravel. Each soil occupies areas ranging from ½ acre to 5 acres in size. The surface layer and subsoil of both soils contain gravel, and their combined thickness is less than is typical for their respective series. Slopes are short and mainly 12 to 15 percent. Included in mapping is Clapper gravelly loam on the steep upper sides of the deepest drainageways. Clapper soils make up about 15 percent of the areas mapped.

This unit is used mostly for range. (Capability unit IVe–4, dryland; Yegen soil is in Sandy range site, 10- to 14-inch precipitation zone; Toluca soil is in Silty range site, 10- to 14-inch precipitation zone)

Formation and Classification of the Soils

In this section, the factors that affect the formation of soils are discussed, the soil series of the county are placed in the higher categories of soil classification, and these categories are defined.

Factors of Soil Formation

Soil is composed of mineral matter mixed with varying amounts of organic matter derived mostly from vegetation. The mineral matter derives from parent material that has been weathered and broken down by the combined effect of climate, living organisms, and topography through long periods of time. Within short distances, the combination of these factors varies, and in consequence the soils that form have different fertility, productivity, and physical and chemical characteristics.

Parent material

Most of the soils in Yellowstone County formed in place over sandstone and shale bedrock. Some soils formed in alluvium derived from sandstone and shale that was deposited in the major valleys and on bordering uplands. Soils that formed in weathered sandstone, such as those in the Toluca series, are generally sandy. The clay these soils contain was an impurity in the sandstone that was released by weathering. Soils that formed in shale, such as those in the Pierre series, are clayey because clay is the basic constituent of shale. Soils that formed in mixed alluvium derived from sandstone and shale, such as those in the McRae series, are loamy. Many of the soils in the county have acquired salt and sodium from the parent material. The salts and sodium make these soils saline or alkali and limit the kinds and amount of plants that can grow on them.

Climate

Climate, an active force in the formation of soils, is determined mainly by temperature and precipitation. Erosion and alternate freezing and heating break down rocks into material in which soils form. The weathered material is further broken down by chemical reactions such as solution and hydration. In this county precipitation ranges from about 10 to 20 inches. In the driest and warmest areas of the county are soils of the Aridisol order, such as those in the Cushman series. In cooler, wetter parts of the county are soils of the Mollisol order, such as those in the Amherst series.

Living organisms

Living organisms also are active in the formation of soils. Organic matter is the main source of the dark color of the surface layer of soils. Fungi and algae are among the earliest inhabitants of rock material that contribute to the decomposition of rocks. As the rocks decompose, grasses, shrubs, and trees are able to grow and support animal life.

The kinds of plants and animals present largely determine the kinds and amount of organic matter added to the soil and how this matter is incorporated with the mineral part of the soil. Roots, rodents, and insects penetrate the soil and influence its structure. Leaves, roots, and whole plants remain in the surface layer where they are changed to humus by micro-organisms, chemicals in the soil, and insects.

The vegetation in Yellowstone County ranges from short and mid grasses and shrubs in most areas to ponderosa pine and juniper trees in the Bull Mountains and Pine Hills. Common rodents are gophers, prairie dogs, badgers, rabbits, and marmots. Pebbles and stones on the surface of terraces and in many other areas have been dug up by burrowing rodents.

Topography

Topography, or relief, is determined by the resistance of bedrock to erosion by water and wind. In the eroded uplands of the county, runoff water has carved deep valleys that have many branches into the original bedrock. The rugged relief contrasts sharply with the smooth low relief of the terraces and flood plains of the river valleys.

In the uplands the number and the distinctness of soil horizons decrease as slope increases. Steep soils that have rapid runoff have many characteristics similar to those of soils formed in arid climates. Level soils that receive runoff water from overlying areas have many of the characteristics of soils that formed in humid climates. An example of this pattern is the shallow Bainville soil that has steep slopes and the deep Big Horn soil in swales and depressions. The Bainville soil has no B horizon, but the Big Horn soil has a B horizon 10 to 15 inches thick.

Time

The changes that take place in a soil over long periods of time are called soil genesis. These changes give the soil distinct horizons, or layers, by which it can be recognized. The kinds and arrangement of these horizons are called soil morphology and are described in terms of color, texture, structure, consistence, thickness, permeability, and chemistry.

Soils are classified as young to mature. The age of a soil is determined from the thickness of the A horizon, the content of organic matter and of clay, the depth to which soluble material is leached, and the form and distribution of calcium carbonate and gypsum in the soil.

Haverson silty clay loam, a soil of the Entisol order, is an example of a young soil. It is on a flood plain adjacent to a flowing stream. The soil contains little organic matter with which to form an A horizon, it has no clay accumulation, and little translocation of carbonates has occurred to form B2 and Cca horizons.

The Farland soils formed in parent material similar to, but much older than, that of Haverson silty clay loam. Farland soils formed in alluvium on uplands and are mature soils of the Mollisol order. They contain enough organic matter to have a dark A horizon. Also, they have a distinct clay accumulation in a B2t horizon, and nearly all the carbonates have been leached from the solum.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, and see their relationships to one another and to the whole environment. Classification also permits us to develop principles that help us to understand soil behavior and response to manipulation. First, through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys, so that knowledge about the soils can be organized and applied in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of classification currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of this system should search the latest literature available (*8*). In table 7, the soil series of Yellowstone County are placed in some categories of the current system. The classes in the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend, generally, to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates.

Table 7 shows the five soil orders in Yellowstone County—Entisols, Mollisols, Aridisols, Alfisols, and Inceptisols. Entisols are recent mineral soils that do not have genetic horizons or have only the beginning of such horizons. Aridisols have a light-colored A horizon, and a zone of translocated carbonates. They are so named because they occur in semiarid or arid climate. Mollisols have surface layers darkened by organic matter. Alfisols have argillic, or clay-enriched, horizons having more than 35 percent base saturation. Inceptisols occur on young but not recent land formations.

SUBORDER: Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The suborder is not shown in table 7.

TABLE 7.—*Classification of soils*

Series	Family	Subgroup	Order
Absarokee	Fine, montmorillonitic	Typic Haploborolls	Mollisols.
Allentine	Fine, montmorillonitic, mesic	Ustollic Natrargids	Aridisols.
Amherst	Clayey, montmorillonitic	Lithic Argiborolls	Mollisols.
Apron	Coarse-loamy, mixed, calcareous, mesic	Typic Torriorthents	Entisols.
Arvada	Fine, montmorillonitic, mesic	Ustollic Natrargids	Aridisols.
Bainville	Fine-silty, mixed, calcareous, mesic	Ustic Torriorthents	Entisols.
Bew	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Big Horn	Fine, montmorillonitic, mesic	Ustollic Paleargids	Aridisols.
Bone	Fine, montmorillonitic, mesic	Ustollic Natrargids	Aridisols.
Clapper	Loamy-skeletal, mixed, mesic	Ustollic Calciorthids	Aridisols.
Cushman	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Danvers	Fine, montmorillonitic	Typic Argiborolls	Mollisols.
Elso	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Farland	Fine-silty, mixed	Typic Argiborolls	Mollisols.
Fattig	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Fort Collins	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Gilt Edge	Fine, montmorillonitic, mesic	Ustollic Natrargids	Aridisols.
Glenberg	Coarse-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols.
Grail	Fine, montmorillonitic	Pachic Argiborolls	Mollisols.
Haverson	Fine-loamy, mixed, calcareous, misce	Ustic Torrifluvents	Entisols.
Haverson (gravelly variant).	Fine-loamy over sandy or sandy-skeletal, mixed, calcareous, mesic.	Ustic Torrifluvents	Entisols.
Heldt	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Hesper	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Hopley	Coarse-loamy, mixed	Typic Haploborolls	Mollisols.
Hovert	Fine, montmorillonitic, mesic	Aquic Natrargids	Aridisols.
Hydro	Fine, montmorillonitic, mesic	Glossic Ustollic Natrargids	Aridisols.
Hysham	Fine-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols.
Judith	Fine-loamy, carbonatic	Typic Calciborolls	Mollisols.
Keiser	Fine-silty, mixed, mesic	Ustollic Haplargids	Aridisols.
Kyle	Fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Lambert	Fine-silty, mixed, calcareous, frigid	Typic Ustorthents	Entisols.
Larim	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Ustollic Haplargids	Aridisols.
Laurel	Fine-loamy, mixed, mesic	Borollic Salorthids	Aridisols.
Lavina	Clayey, montmorillonitic, mesic	Aridic Lithic Argiustolls	Mollisols.
Lismas	Clayey, montomorillonitic, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Lohmiller	Fine, montmorillonitic, calcareous, mesic	Ustic Torrifluvents	Entisols.
Lohmiller (gravelly variant).	Fine over sandy or sandy-skeletal, mixed, calcareous, mesic.	Ustic Torrifluvents	Entisols.
Maginnis	Clayey, skeletal, montmorillonitic, frigid	Lithic Haploborolls	Mollisols.
McKenzie	Fine, montmorillonitic, calcareous, frigid	Typic Haplaquepts	Inceptisols.
McRae	Fine-loamy, mixed, mesic	Ustollic Camborthids	Aridisols.
Midway	Clayey, montmorillonitic, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Oburn	Fine, montmorillonitic	Borollic Natrargids	Aridisols.
Pierre	Very fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Razor	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Ryegate	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Sage	Fine, montmorillonitic, mesic	Ustollic Salorthids	Aridisols.
Shaak	Fine, montmorillonitic	Abruptic Argiborolls	Mollisols.
Shonkin	Fine, montmorillonitic, mesic	Glossic Natraqualfs	Alfisols.
Shorey	Fine-loamy, mixed, mesic	Ustollic Calciorthids	Aridisols.
Thurlow	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Toluca	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Travessilla	Loamy, mixed, calcareous, mesic	Lithic Ustic Torriorthents	Entisols.
Treasure	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Vananda	Fine, montmorillonitic, mesic	Ustic Torriorthents	Entisols.
Wanetta	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Ustollic Haplargids	Aridisols.
Work	Fine, montmorillonitic	Typic Argiborolls	Mollisols.
Worland	Coarse-loamy, mixed, calcareous, mesic	Typic Torriorthents	Entisols.
Wormser	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Yegen	Fine-loamy, mixed	Typic Argiborolls	Mollisols.

GREAT GROUP: Soil suborders are separated into great groups on the basis of uniformity in the kinds, sequence, and characteristics of major soil horizons. The horizons used to make separations into great groups are those in which clay, iron, or humus have accumulated or those that have pans interfering with growth of roots or movement of water. Among the characteristics considered are the self-mulching properties of clays, soil temperature, and major differences in the content of calcium, magnesium, sodium, and potassium. The great group is not shown separately in table 7 because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of one great group and also one or more properties

of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES: As explained in the section "How This Survey Was Made," the series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and arrangement in the profile. A series is given the name of a geographic location near the place where that series was first observed and mapped.

General Nature of the County

This section discusses the physiography and drainage, ground water sources, climate, natural resources, settlement and farming, and industry, markets and transportation of the county. Statistics for population and agriculture are from reports by the U.S. Bureau of the Census and the Department of Agriculture.

Physiography and Drainage

Yellowstone County lies in an unglaciated part of the Missouri Plateau, which is the northern part of the Great Plains Province. It is underlain by sedimentary rocks, chiefly sandstone and shale. The topography is the result of differential erosion that followed the folding and faulting of these rocks.

Elevation ranges from 2,680 feet above sea level on the Yellowstone River near Custer to 4,700 feet on Eldrige Mesa in the Bull Mountains. Local relief is generally less than 600 feet, except in the Bull Mountains, and changes in elevation generally are gradual.

The topography of the county can be divided into the Bull Mountain upland, the plains, the lake basins, the zone of faulting, the terraces, and the Yellowstone River valley.

A small part of the Bull Mountains is included in Yellowstone County. This part is rugged and has a maximum local relief of less than 2,000 feet. The climate is semiarid. Runoff after heavy rains causes severe erosion on the nearly horizontal beds of sandstone, soft shale, and coal. Streams flow intermittently and carry a large volume of water when rains are heavy. Because slopes are steep, the streams also carry large amounts of silt. Because the coalbeds have burned, the rocks at high elevations have fused into natural brick. This red clinker, or scoria brick, crops out above and below the coalbeds.

The largest part of the county is plains. The plains are rolling and dissected. Sandstone and shale crop out. The shale weathers faster than the sandstone and forms rimrocks, steep-sided coulee walls, and rough ridges. Areas where the shale is thickest are more rolling and dissected than other areas. This is because the cover of plants is sparse, runoff is rapid, and erosion is severe.

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The lake basins in the northwestern part of the county are undrained or poorly drained depressions containing temporary lakes that vary in size. The largest in the county is the 15,000-acre Comanche Flat south of Broadview. The Comanche Flat lies 650 feet above the Yellowstone River and drains southward. General uplift along the Huntley fault zone, which crosses the Comanche Flat near Acton in an east-west direction, may have reduced the gradient of the river. This uplift combined with general uplift in the Pryor and Beartooth Mountains during the Tertiary period helped to downcut the river and to dam up the Comanche Flat.

The Huntley fault zone, generally less than 7 miles wide, crosses the county through Huntley in the east to Acton in the west. The faults cut northeastward across the fault zone at about a 45° angle. Each fault is generally less than 5 miles long and has a displacement of less than 500 feet. Along the fault zone are broken and irregular beds, sandstone scarps, and buttes. The fossil beds southwest of Acton are in this zone.

Large areas in the county are covered with gravelly alluvium. This alluvium occurs along the Yellowstone River Valley and in areas south of the valley. In the valley two terraces show signs that there were periods of uplift and periods of relative stability. The lowest terrace is about 125 feet above the Yellowstone River and contains gravel to a depth of 25 to 50 feet. This terrace is represented by the Billings Bench east of Billings. The highest terrace is 600 to as much as 1,100 feet above the river. It occurs south of the river, south of Huntley and Ballantine, and along the entire length of Pryor Creek. The highest terraces are associated with former drainage systems at much higher elevation and may date from the Oligocene epoch, about 30 million years ago. The highest terraces may be associated with the ancient valley of the Shoshone River, or they may be remnants of the Yellowstone River Valley from a period when the river flowed at a much higher elevation than it does today. The Shoshone River once flowed northward through Pryor Gap but since has been partly replaced by the Pryor Creek drainage system.

The Yellowstone River Valley ranges from a few hundred yards to about 12 miles in width and lies 100 to 500 feet below the surrounding upland plain. The width of the valley is determined by the resistance of the bedrock to erosion. The valley is broader over shale than over the harder sandstone. East of Billings the river has cut around the resistant Eagle Sandstone, which now forms prominent rimrocks on both sides of the valley. Eagle Sandstone, on which Billings Airport is located, lies 500 feet above the river.

All of Yellowstone County is drained by the Yellowstone River and its tributaries. The river flows northeastward through a fairly steep walled valley. It ranges from a few hundred feet to more than half a mile in width, and it always carries a large volume of water. The maximum flow recorded at Billings between 1928 and 1958 was 64,800 second-feet, and the minimum flow was 430 second-feet. The only tributaries of the river that carry water the year round are Clarks Fork and Pryor Creek. The headwaters of Clarks Fork are in the Beartooth and Absaroka Mountains, and the headwaters of Pryor Creek are in the Pryor Mountains.

Ground Water Sources [5]

Yellowstone County is underlain by beds of shale and sandstone that are about 5,000 feet thick. The shale is generally dry or yields water of poor quality, but in some areas it yields water that can be used by livestock. The most practical way to obtain water from shale is to dig shallow wells in coulees or to drill through the shale to underlying sandstone (*4*).

The sandstone yields water adequate in quantity and quality for both domestic and livestock use. The sandstone does not yield enough water for large-scale irrigation, and the water is too mineral for use on the soils in this county. The water obtained from areas where sandstone is covered by thick marine shale may be of poor quality.

The rocks that crop out in Yellowstone County date from the Quaternary to the Jurassic Periods and were deposited as long as 140 million years ago. Older, deeper rocks of the Swift, Tensleep, Amsden, and Madison Limestone Formations contain water under pressure sufficient for artesian wells.

Quaternary alluvium and lower terrace deposits.—The youngest sediments are on fans and valleys of the Yellowstone River and its tributaries. The most extensive deposits occur in the valleys of the Yellowstone River and Clarks Fork and on Comanche Flat. Groundwater from the river valleys is generally suitable for domestic and livestock use and can be obtained in the valleys or on the terraces. In some areas contamination and higher salt content preclude domestic use of the water. The water from Comanche Flat contains large amounts of salt and is suitable only for livestock.

Other terrace deposits.—The alluvium deposits on high terraces south of the Yellowstone River Valley are deeply dissected and have been drained of ground water. They serve mainly as aquifers from small springs or seeps at the terrace edges. The gravel mantle is about 25 feet thick in most places. It is similar to the gravel mantle on lower terraces, but it contains more quartzite, dark chert, and igneous rocks and is cemented in many areas.

Fort Union Formation.—The Fort Union Formation consists of Tertiary rocks 40 to 60 million years old. It underlies most of the eastern part of the county and is an important source of water. This formation is more than 2,000 feet thick in the Bull Mountains, though it thins out from this structural base.

The Fort Union Formation is divided into the Tullock member at the base, the Lebo Shale member in the middle, and the Tongue River member at the top. All members are composed of interbedded shale and small amounts of sandstone and coal. Spring and well water sufficient for use by livestock can be obtained from the sandstone, except in well-drained areas high above the valley. Water can be obtained from shallow wells in areas of the valley that are underlain by shale.

Hell Creek Formation.—The Hell Creek Formation consists of Cretaceous rocks, 60 to 130 million years old. It is about 1,100 feet thick and underlies the Fort Union Formation. The Hell Creek Formation crops out at the surface in many areas throughout the county. Most wells yield only a small quantity of water. The yield is especially low in areas underlain by very permeable sandstone. The water contains more minerals than water from the Fort Union Formation, but it is generally satisfactory for use by livestock and, in some areas, for domestic use.

Lennep Sandstone.—Lennep Sandstone underlies the Hell Creek Formation and crops out only in the northwestern part of the county. This formation is about 300 feet thick and, in many areas, forms a prominent escarpment above the underlying Bearpaw Shale. Lennep Sandstone is a good aquifer except where it is contaminated by mineralized water from the Bearpaw Shale.

Bearpaw Shale.—Bearpaw Shale is dark-blue to gray-black marine shale 600 to 1,000 feet thick. It contains little or no sandstone and yields satisfactory water only in some shallow wells in valleys. Surface reservoirs in areas where Bearpaw Shale crops out are generally a fair source of water for livestock.

Judith River Formation.—The Judith River Formation underlies the Bearpaw Shale and is about 400 feet thick. It consists of alternating layers of sandstone and shale. The sandstone and shale in the western part of the county formed in fresh water. In the eastern part of the county they formed in brackish water as a shoreline deposit of a large Cretaceous sea.

The sandstone of the Judith River Formation generally yields water of fair to good quality. Water of poorer quality is obtained where wells are drilled through the Bearpaw Shale because mineralized water from the shale can enter the sandstone at outcrops and along faults and fractures.

Claggett Formation.—The Claggett Formation is dark shale about 600 feet thick. It is similar to Bearpaw Shale. This shale is of marine origin and yields water of poor quality because the permeability of the formation is slow and the salt content is high. Satisfactory water can be obtained by drilling through the Claggett Shale into the underlying Eagle Sandstone. In some areas the Eagle Sandstone may be contaminated by salts derived from the overlying Claggett Shale.

Eagle Sandstone.—Eagle Sandstone underlies Claggett Shale. It is nearly 300 feet thick in the western part of the county. The upper part is thin-bedded sandstone and shale, the middle is shaly, and the lower part is massive sandstone that forms prominent rimrocks along parts of the Yellowstone River valley. The sandstone is cemented and has slow permeability. Most wells yield a small quantity of hard water that is generally potable.

Telegraph Creek Formation.—The Telegraph Creek Formation occurs in the southern part of the county. It is part of a transition zone about 150 to 200 feet thick between Eagle Sandstone and Colorado Shale. It consists primarily of thin-bedded sandstone and shale of marine origin. The poorly developed marine sandstone is not a reliable source of potable water.

Cody Shale.—Cody Shale lies below the Telegraph Creek Formation and is 500 to 1,100 feet thick. It consists mostly of gray to black marine shale that yields little or no water. Sandy zones occur locally, but the water they yield generally is not potable.

Frontier Formation.—The Frontier Formation lies below the Cody Shale and is about 450 to 800 feet thick.

[5] Prepared by HOWARD SMITH, geologist, Soil Conservation Service.

It consists of black shale, brown sandy shale, and heavy sandstone that is primarily of marine origin. This formation yields little or no water.

Mowry Shale.—Mowry Shale lies below the Frontier Formation and is 180 to 325 feet thick. It consists of thin-bedded sandstone and shale. Weathered outcrops of Mowry Shale are silver-gray in color. Mowry Shale does not yield potable water.

Thermopolis Shale.—Thermopolis Shale consists of a lower layer of sandy shale about 275 feet thick, a middle layer of stream-deposited sandstone 10 to 30 feet thick, and an upper layer of black or dark blue-gray shale 400 to 460 feet thick. In valleys the lower and upper layers of shale are separated by sandstone benches. The sandstone is a potential source of oil but does not yield potable water.

Cloverly Formation.—The Cloverly Formation is 150 to 350 feet thick and is of fresh water origin. It crops out at an elevation of about 3,800 feet on the northern slopes of the Pryor Mountains. Most wells drilled in the valley below yield an ample amount of potable water.

Morrison Formation.—The Morrison Formation is about 200 feet thick. It dates from the Jurassic Age and is of fresh-water origin. It crops out in only a few areas of the county and is not an important source of water.

Older rocks.—Older sedimentary rocks that are more than 3,000 feet thick can be reached by drills. Those that contain or consist of sandstone have good permeability and are suitable sources of water.

Climate

The climate of Yellowstone County is affected by a complex topography of mountains, foothills, and valleys. The county is situated in the west-central part of the Yellowstone River Valley and east and north of mountainous areas. The main valley drains generally northeastward through the county, but slopes and drainageways in some parts of the county go in almost all directions. Elevation ranges from about 2,200 feet above sea level where the Yellowstone River leaves the county east of Custer to more than 5,000 feet along parts of the southern boundary. Elevation rises rapidly in the southwestern part of the county to the highest peaks in Montana, about 50 miles beyond the border. To the south elevation is about 10,000 feet in the Big Horn Mountains along the Wyoming State line.

Data on temperature and precipitation in the county are given in table 8. Temperatures are higher in summer and milder in winter in the Yellowstone River Valley than elsewhere in the county. Precipitation in the valley is less than 14 inches and is as low as 11 inches near Custer on the eastern border.

In the uplands north and south of the main valley, precipitation is about 15 inches. It is nearly 20 inches in the areas of Bull Mountain and Pryor Mountain. The temperatures are lower and the growing season is shorter than in the valley.

Cold fronts from the north affect the eastern part of the county but do not reach the western part. Consequently, winter in the east and at higher elevations is more severe than in the western valley region near Billings.

The length of the growing season varies little in cultivated areas throughout the county. The frost-free season averages 129 days between the last freezing temperature in spring on about 15 May and the first in fall on about 22 September.

Figure 7 shows the percentage of probability that specified freezing temperatures will occur at Ballantine after a given date in spring. Figure 8 shows the percentage of probability that these temperatures will occur before a given date in fall.

Warm, dry chinook winds that blow down the sides of mountains move northeastward through the county and make winters relatively mild. In downtown Billings the average temperature in January is 35.2° F., which is 10° higher than at stations 100 miles east or west of the county. Over a 25-year period at Billings Airport, there was an average of 43 days per year when the temperature remained below 32° F. all day, and 16 days per year when the temperature fell below 0° F. during the day. A low of −53° F. has been recorded at the Huntley Experiment Station, but winter temperatures seldom drop below −20 to −25° F.

Average temperatures are lower outside the main valley. Broadview was an average of 2.5° colder than Billings in the winter of 1956–57, and eastern sections of the county are affected by cold air from the north that does not reach the western sections.

On about 92 days a year precipitation is 0.01 inch or more, and nearly 70 percent of the annual precipitation falls during the growing season. May and June are the wettest months. Both have about 11 days when precipitation is 0.01 inch or more. This is favorable for crop growth. More precipitation falls in June than falls in July and August combined. This means that in most years hay and small grains can be harvested during July and August without much interruption by wet weather.

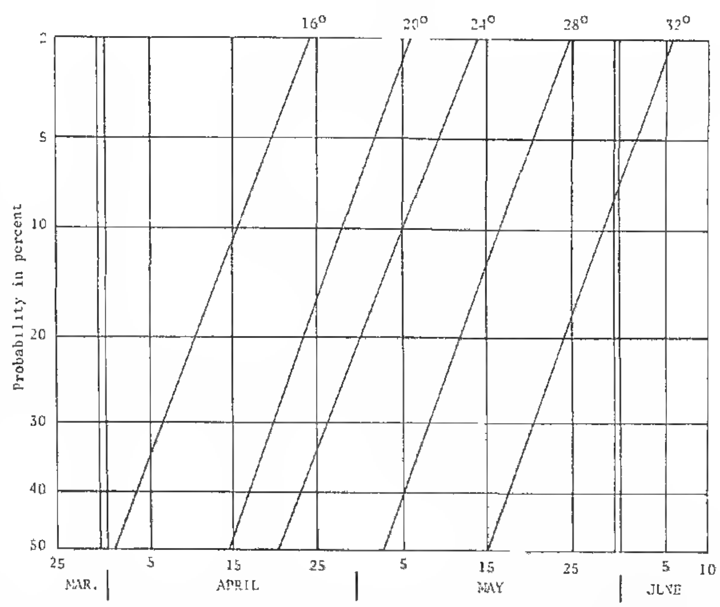

***Figure 7.*—Percentage of probability that a temperature of 16°, 20°, 24°, 28°, and 32° will occur at Ballantine after given dates in spring.**

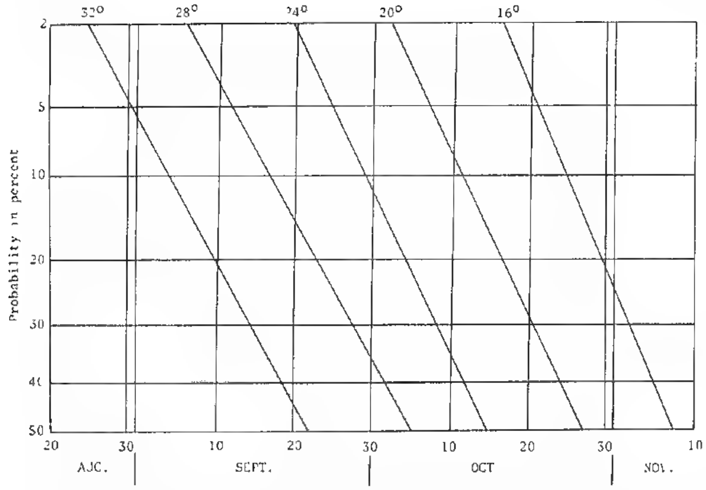

***Figure 8.*—Percentage of probability that a temperature of 16°, 20°, 24°, 28°, and 32° will occur at Ballantine before given dates in fall.**

A second peak of precipitation occurs in September and October, and it improves the germination and early growth of winter wheat, the major dryfarmed crop.

The highest summer temperatures occur in the Yellowstone River Valley. The temperature reaches 100° F. a few days every year, and a high of 110° F. has been recorded at Ballantine. The maximum afternoon temperature in July is 88 to 91° F., but the temperature drops below 60° F. at night. Hot spells in July and August can affect most dryfarmed crops, but irrigated crops are less vulnerable.

No more than twice in 10 years are seasons dry enough to harm dryfarmed crops. In a 50-year period, the Huntley Experiment Station recorded 10 years having an annual precipitation of less than 10 inches, but the total precipitation in the months of May and June, the most important for summer crops, remained high even during the dry years.

About 31 thunderstorms occur each year, 16 of which are in June and July. Hail during thunderstorms damages crops or property in some parts of the county every year.

Heavy snowstorms are rare. About 19 days a year have more than 1 inch of snow. March, the snowiest month, has 4 days on which 1 inch or more of snow falls. Annual snowfall in the Yellowstone River Valley averages about 40 inches a year, but probably twice this amount falls at elevations of 4,500 feet or more.

The prevailing winds in the county blow toward the northeast. At Billings windspeed averages 9.6 miles per hour in August and 12.9 miles per hour in December. Windspeed is faster in winter because the chinook or drainage winds blow for days at a time. These winds make winter temperatures milder throughout the county.

Gusty winds accompany summer thunderstorms, and about once every 10 years a tornado occurs somewhere in the county. The tornadoes usually are small.

At Billings Airport through a 20-year period, the sun shone 62 percent of the possible time throughout the year. July (78 percent) and August (76 percent) are the sunniest months, and November and December (47 percent) are the cloudiest. These conditions prevail throughout the county.

Tests at Huntley using evaporation pans showed that about 40 inches of water are lost by evaporation from April through September. The loss is considerably greater in the windier sections of the county. Evaporation from lakes or reservoirs averages 28 inches of water from April through September, but varies from about 22 inches during cool, wet years to as much as 40 inches during hot, dry years.

At Billings Airport the relative humidity has a high of 77 percent during June at about 5:00 a. m., and a low of 32 percent during August at about 5:00 p. m. On clear, dry summer afternoons the relative humidity may drop

TABLE 8.—*Temperature and precipitation*

Month	Temperature [1]			Precipitation		
	Average daily maximum	Average daily minimum	Mean daily temperature	Billings Airport [2]	Huntley Experiment Station [2]	Average snowfall [3]
	° F.	° F.	° F.	Inches	Inches	Inches
January	32. 5	10. 6	23. 2	0. 61	0. 35	6. 8
February	36. 1	13. 1	25. 7	0. 62	0. 41	7. 1
March	44. 4	22. 0	33. 7	1. 01	0. 66	8. 9
April	59. 4	32. 9	46. 0	1. 45	1. 16	4. 0
May	69. 5	42. 7	56. 8	2. 08	1. 96	0. 5
June	76. 9	50. 1	65. 1	2. 61	2. 66	0. 2
July	88. 3	56. 4	74. 7	0. 89	0. 80	0
August	85. 9	53. 8	71. 9	0. 83	0. 81	0
September	73. 6	44. 6	60. 4	1. 26	1. 22	0. 6
October	61. 7	35. 1	49. 5	1. 01	0. 86	2. 5
November	46. 4	23. 6	35. 1	0. 67	0. 51	4. 7
December	36. 5	15. 3	28. 4	0. 59	0. 46	6. 9
Year	59. 2	33. 3	47. 5	13. 68	11. 88	42. 2

[1] Average of temperatures at Billings Airport and the Huntley Experiment Station.

[2] Average monthly precipitation based on data for the period 1935–64.

[3] Based on snowfall at Ballantine through a period of 21 years.

to 20 to 30 percent. Because the relative humidity is low, summer weather is seldom oppressive. High relative humidity occurs during fog, but the fog usually lasts no more than a few hours.

Natural Resources

The Wolf Springs oilfield in the northeastern part of the county has about 30 producing wells in an area 6 miles square. The crude oil is refined in Billings. Attempts to extend the oilfield into Musselshell County north of Yellowstone County have been unsuccessful.

Subbituminous coal is obtained in the Bull Mountains from sedimentary rocks of the Fort Union formation. The coal is consumed locally. Mining has not developed on a commercial scale because the major coalbeds in the formation are in Musselshell County to the north.

Timberland is generally part of ranch sites and is grazed. Cottonwood trees grow in about 10,000 acres on bottom lands of the Yellowstone and Bighorn Rivers and Clarks Fork. Ponderosa pine trees grow on the southern slopes of the Bull Mountains and in the areas south and west of Custer. These trees provide mine timber and lumber for local use. Small portable sawmills produce the lumber.

Sand and gravel underlying river terraces are used locally for constructing roads and buildings. Small amounts of shale are used to produce bricks and building blocks.

Settlement and Farming

Yellowstone County was incorporated in 1882. The Northern Pacific Railroad reached the Yellowstone River Valley in 1883, and thereafter irrigated farming expanded rapidly. Between 1907 and 1917 nearly all tillable land outside the irrigated valleys was homesteaded, except for the Crow Indian Reservation, which occupies about 221,180 acres in the southeastern part of the county.

The Huntley Agricultural Experiment Station was established in 1900. Late in the 1930's, the Federal government purchased most of the dryfarmed land in the county. The Buffalo and Alkali Creek Grazing Districts were created, formerly dryfarmed areas were reseeded to range, and water developments and controlled grazing were introduced to improve the rangeland. In 1952 about 73,432 acres of dryland was still federally owned.

In 1964 there were 1,085 farms and ranches in the county. Of these 830 were irrigated. Table 9 shows the major irrigated and dryfarmed field crops in the county. About 80 percent of the farms are operated by the owner, and nearly all of them are served by electric powerlines and are mechanized.

In 1964 there were 382 livestock farms other than poultry and 14 poultry farms. Table 10 gives the livestock for 1959 and 1964. Other farms in the county were 446 farms growing field crops, 176 cash-grain farms, and 61 dairy farms.

TABLE 9.—*Acreage of principal crops in 1959 and 1964*

Crop	1959	1964
	Acres	*Acres*
Sugar beets	14, 058	14, 667
Alfalfa hay	22, 321	23, 659
Beans	4, 317	2, 810
Corn for silage	8, 438	7, 496
Winter wheat	71, 669	65, 977
Spring wheat	7, 706	5, 475
Oats	5, 839	4, 320
Barley	37, 218	34, 217

TABLE 10.—*Livestock*

Livestock	1959	1964
Cattle and calves	81, 827	110, 617
Sheep and lambs	49, 526	31, 831
Hogs and pigs	8, 651	6, 386
Chickens (4 months and older)	95, 160	96, 987

Industry, Markets, and Transportation

Oil refineries at Billings and Laurel produce many kinds of oil products, including jet aircraft fuel. A large sugar refinery at Billings is supplied with sugar beets grown locally and around Chinook, near the Canadian border. Two meat packing plants, a vegetable packing plant, and a flour mill are located in Billings.

Natural gas pipelines supply heating fuel to all the major towns and cities in the county. Billings has a standby generating plant for electric power, but the main source of electricity is outside of the county.

Wheat is marketed at elevators in Broadview, Acton, Billings, Laurel, Huntley, and Worden. The public stockyards and transportation to Billings provide ranches with good livestock marketing facilities. Billings is also a distribution point for wholesale firms that deal in farm machinery, groceries, construction and oilfield equipment, and the service industries connected with them.

The railway system includes the main line of the Northern Pacific Railroad and branch lines of the Chicago, Burlington, and Quincy and the Great Northern Railroads. Repair shops and switching yards are at Laurel. Interstate Highways 90 and 94 cross the county along the Yellowstone River Valley and U.S. Highway 87 crosses the county from north to south. U.S. Route 212 is the northeast entrance to Yellowstone National Park. The terminals of several major truck companies that transport oil and other products are at Billings and Laurel. Three major airlines fly to the Billings Airport.

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The capacity of a soil to hold water in a form available to most plants.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Decreaser. Any of the climax range plants most heavily grazed. Because they are the most palatable, they are first to be destroyed by overgrazing.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon. The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Increasers. Species in the climax vegetation that increase in relative amount as the more desirable plants are reduced by close grazing; increasers commonly are shorter than decreasers, and some are less palatable to livestock.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow*, *slow*, *moderately slow*, *moderate*, *moderately rapid*, *rapid*, and *very rapid*.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Range condition. The state of health or productivity of both soil and forage in a given range, in terms of what productivity could or should be under normal climate and the best practical management. Condition classes generally recognized are—*excellent*, *good*, *fair*, and *poor*. The classification is based on the percentage of original, or climax, vegetation on the site, as compared to what ought to grow on it if management were good.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeters) to the lower limit of very fine sand (0.05 millimeters). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Substratum. Technically the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. An explanation of the capability classification begins on page 10. Windbreak groups are described on pages 23 and 24. Other information is given in tables as follows:

Predicted yields of irrigated crops, table 1, page 18.
Predicted yields of dryfarmed crops, table 2, page 21.
Use of the soils in engineering, tables 3, 4, and 5, pp. 30 through 69.
Acreage and extent, table 6, page 72.

			Capability unit				Range site		Windbreak suitability group
			Irrigated		Dryland				
Map symbol	Mapping unit	Page	Symbol	Page	Symbol	Page	Name	Page	Number
Aa	Absarokee clay loam, 1 to 4 percent slopes	74	--	--	IIe 2	14	Silty, 15- to 19-inch precipitation zone	27	2
Ab	Absarokee clay loam, 4 to 7 percent slopes	74	--		IIIe 4	14	Silty, 15- to 19-inch precipitation zone	27	2
Ag	Alluvial land, gravelly	75	--	--	VIw-2	16	Shallow to Gravel, 10- to 14-inch precipitation zone	28	4
Al	Alluvial land, mixed	75	--	--	VIw-2	16	Shallow to Gravel, 10- to 14-inch precipitation zone	28	4
Am	Alluvial land, seeped	75	--	--	Vw-1	16	Wetland, 10- to 14-inch precipitation zone	25	(1/)
An	Alluvial land, wet	75	--	--	Vw-1	16	Wetland, 10- to 14-inch precipitation zone	25	--
Ao	Amherst clay loam, 7 to 15 percent slopes	76	--	--	IVe-3	15	Silty, 15- to 19 inch precipitation zone	27	3
Ap	Amherst Maginnis channery clay loams, 4 to 7 percent slopes	76	--	--	IVe-3	15	Silty, 15- to 19-inch precipitation zone	27	3
Ar	Apron loamy fine sand, 4 to 7 percent slopes	76	--	--	IVe-2	15	Sands, 10- to 14-inch precipitation zone	26	2
As	Apron fine sandy loam, 4 to 7 percent slopes	76	--	--	IVe-2	15	Sandy, 10- to 14-inch precipitation zone	26	2
At	Apron-Travessilla loamy fine sands, 7 to 15 percent slopes	76							
	Apron loamy fine sand	--	--	--	VIe-2	16	Sands, 10- to 14-inch precipitation zone	26	2
	Travessilla loamy fine sand	--	--	--	VIe-2	16	Shallow Limy, 10- to 14-inch precipitation zone	28	4
Au	Arvada clay loam, 0 to 1 percent slopes	77	IVs-2	13	VIs-1	16	Silty, 10- to 14-inch precipitation zone	27	--
Av	Arvada clay loam, 1 to 4 percent slopes	77	IVs 2	13	VIs-1	16	Silty, 10- to 14-inch precipitation zone	27	--
Aw	Arvada clay loam, 4 to 7 percent slopes	77	--	--	VIs 1	16	Silty, 10- to 14-inch precipitation zone	27	--
Ax	Arvada-Bone silty clay loams, 0 to 1 percent slopes	77							
	Arvada silty clay loam	--	--	--	VIIs-2	17	Silty, 10 to 14-inch precipitation zone	27	--
	Bone silty clay loam	--	--	--	VIIs-2	17	Saline Upland, 10 to 14-inch precipitation zone	28	--

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
Ay	Arvada-Bone clays, 0 to 1 percent slopes	78							
	Arvada clay	--	--------	--	VIIs-2	17	Clayey, 10- to 14-inch precipitation zone	27	--
	Bone clay	--	--------	--	VIIs-2	17	Saline Upland, 10- to 14-inch precipitation zone	28	--
Bb	Bainville loam, 2 to 7 percent slopes	78	--------	--	IVe-4	16	Silty, 10- to 14-inch precipitation zone	27	--
Bc	Bainville loam, 7 to 15 percent slopes	78	--------	--	VIe-4	16	Silty, 10- to 14-inch precipitation zone	27	3
Be	Bainville-Elso complex, 15 to 35 percent slopes	79							
	Bainville loam	--	--------	--	VIe-4	16	Thin Silty, 10- to 14-inch precipitation zone	27	3
	Elso clay loam	--	--------	--	VIe-4	16	Thin Silty, 10- to 14-inch precipitation zone	27	4
Bf	Bainville-Elso-Shale outcrop complex, 7 to 25 percent slopes	79							
	Bainville loam	--	--------	--	VIe-4	16	Thin Silty, 10- to 14-inch precipitation zone	27	3
	Elso clay loam	--	--------	--	VIe-4	16	Thin Silty, 10- to 14-inch precipitation zone	27	4
	Shale outcrop	--	--------	--	---------	--	----------------------	--	--
Bg	Bainville-Rock outcrop complex, 15 to 45 percent slopes	79	--------	--	VIe-4	16	Thin Silty, 10- to 14-inch precipitation zone	27	3
Bl	Bainville-Worland complex, 4 to 7 percent slopes	79							
	Bainville loam	--	--------	--	IVe-4	16	Silty, 10- to 14-inch precipitation zone	27	3
	Worland fine sandy loam	--	--------	--	IVe-4	16	Sandy, 10- to 14-inch precipitation zone	26	3
Bm	Bew silty clay loam, 0 to 1 percent slopes	80	IIs-1	11	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	2
Bn	Bew clay, 0 to 1 percent slopes	80	IIIs-1	12	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	3
Bo	Bew clay, 1 to 4 percent slopes	80	IIIe-1	12	IIIe-3	14	Clayey, 10- to 14-inch precipitation zone	27	3
Br	Bew-Allentine clays, 0 to 1 percent slopes	80							
	Bew clay	--	IIIs-1	12	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	3
	Allentine clay	--	IIIs-1	12	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	4
Bs	Big Horn clay loam, 0 to 2 percent slopes	81	--------	--	IIIc-1	15	Clayey, 10- to 14-inch precipitation zone	27	2
Bt	Bone silty clay, 0 to 1 percent slopes	82	--------	--	VIIs-2	17	Saline Upland, 10- to inch precipitation zone	28	--

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
Bu	Bone silty clay, 1 to 6 percent slopes	82	--------	--	VIIs-2	17	Saline Upland, 10- to 14-inch precipitation zone	28	--
Bv	Bone clay, 0 to 1 percent slopes	82	--------	--	VIIs-2	17	Saline Upland, 10- to 14-inch precipitation zone	28	--
Ca	Clapper clay loam, 15 to 35 percent slopes	83	--------	--	VIe-4	16	Thin Silty, 15- to 19-inch precipitation zone	27	4
Cg	Clapper gravelly loam, 7 to 15 percent slopes	83	--------	--	VIe-4	16	Thin Silty, 10- to 14-inch precipitation zone	27	4
Ch	Cushman-Bainville loams, 1 to 4 percent slopes	83							
	Cushman loam	--	--------	--	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
	Bainville loam	--	--------	--	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
Cm	Cushman-Bainville loams, 4 to 7 percent slopes	84							
	Cushman loam	--	--------	--	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
	Bainville loam	--	--------	--	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
Da	Danvers silty clay loam, 2 to 4 percent slopes	84	--------	--	IIe-2	14	Silty, 15- to 19-inch precipitation zone	27	3
Dn	Danvers silty clay loam, 8 to 15 percent slopes	85	--------	--	IVe-3	15	Silty, 15- to 19-inch precipitation zone	27	3
Dr	Danvers-Judith complex, 7 to 15 percent slopes	85	--------	--	IVe-3	15	Silty, 15- to 19-inch precipitation zone	27	3
Ds	Danvers-Shaak clay loams, 7 to 15 percent slopes	85	-------	--					
	Danvers clay loam	--	--------	--	IVe-3	15	Silty, 15- to 19-inch precipitation zone	27	3
	Shaak clay loam	--	--------	--	IVe-3	15	Silty, 15- to 19-inch precipitation zone	27	2
Ec	Elso clay loam, 4 to 7 percent slopes	85	--------	--	IVe-4	16	Clayey, 10- to 14-inch precipitation zone	27	4
El	Elso clay loam, 7 to 15 percent slopes	86	--------	--	VIe-4	16	Clayey, 10- to 14-inch precipitation zone	27	4
Eo	Elso clay loam, 15 to 60 percent slopes	86	--------	--	VIe-4	16	Thin Clayey, 10- to 14-inch precipitation zone	28	4
Es	Elso-Lohmiller complex, 15 to 35 percent slopes	86							
	Elso clay loam	--	--------	--	VIe-4	16	Thin Clayey, 10- to 14-inch precipitation zone	28	4
	Lohmiller clay loam	--	--------	--	VIe-4	16	Clayey, 10- to 14-inch precipitation zone	27	2

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
Fa	Farland-Lambert silt loams, 0 to 4 percent slopes----------	87							
	Farland silt loam------------	--	--------	--	IIe-2	14	Silty, 15- to 19-inch precipitation zone	27	1
	Lambert silt loam------------	--	--------	--	IIe-2	14	Silty, 15- to 19-inch precipitation zone	27	2
Fg	Fattig sandy clay loam, 4 to 7 percent slopes-----------------	87	--------	--	IIIe-7	15	Sandy, 10- to 14-inch precipitation zone	26	3
Fl	Fort Collins-Arvada clay loams, 0 to 1 percent slopes----------	88							
	Fort Collins clay loam-------	--	IIs-2	11	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	2
	Arvada clay loam-------------	--	IIs-2	11	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	--
Fo	Fort Collins-Arvada clay loams, 1 to 4 percent slopes----------	88							
	Fort Collins clay loam-------	--	IIe-1	11	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	2
	Arvada clay loam-------------	--	IIe-1	11	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	--
Fr	Fort Collins and Thurlow clay loams, 0 to 1 percent slopes---	88	I-1	10	IIIc-1	15	Clayey, 10- to 14-inch precipitation zone	27	2
Ft	Fort Collins and Thurlow clay loams, 1 to 4 percent slopes---	88	IIe-1	11	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	2
Ga	Gilt Edge-Allentine complex, 2 to 7 percent slopes----------	89							
	Gilt Edge loam---------------	--	--------	--	IVe-5	16	Silty, 10- to 14-inch precipitation zone	27	4
	Allentine clay---------------	--	--------	--	IVe-5	16	Clayey, 10- to 14-inch precipitation zone	27	4
Gh	Glenberg fine sandy loam, 1 to 4 percent slopes-----------------	90	IIe-1	11	IVe-2	15	Sandy, 10- to 14-inch precipitation zone	26	2
Gl	Glenberg loam, 0 to 1 percent slopes-------------------------	90	I-1	10	IIIc-1	15	Silty, 10- to 14-inch precipitation zone	27	2
Go	Glenberg loam, gravelly substratum, 0 to 1 percent slopes-	90	IIs-3	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
Gr	Grail clay loam, 2 to 4 percent slopes-------------------------	90	IIe-1	11	IIe-2	14	Clayey, 10- to 14-inch precipitation zone	27	2
Gs	Grail silty clay, 0 to 1 percent slopes-------------------------	91	IIs-1	11	IIs-4	14	Clayey, 15- to 19-inch precipitation zone	27	3
Gt	Grail soils, 2 to 15 percent slopes-------------------------	91							
	Grail clay loam--------------	--	--------	--	IIIe-4	14	Clayey, 15- to 19-inch precipitation zone	27	2
	Grail silty clay loam--------	--	--------	--	IIIe-4	14	Overflow, 15- to 19-inch precipitation zone	26	2
	Grail silty clay-------------	--	--------	--	IIIe-4	14	Overflow, 15- to 19-inch precipitation zone	26	2

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
Ha	Haverson loam, 0 to 1 percent slopes-------------------------	91	I-1	10	IIIc-1	15	Silty, 10- to 14-inch precipitation zone	27	2
Hb	Haverson loam, clay substratum, 0 to 1 percent slopes----------	91	IIs-2	11	IIIs-3	15	Silty, 10- to 14-inch precipitation zone	27	2
Hc	Haverson clay loam, 0 to 1 percent slopes-----------------	92	I-1	10	IIIc-1	15	Clayey, 10- to 14-inch precipitation zone	27	2
Hd	Haverson silty clay loam, 0 to 1 percent slopes-----------------	92	I-1	10	IIIc-1	15	Clayey, 10- to 14-inch precipitation zone	27	2
He	Haverson silty clay loam, 1 to 3 percent slopes-----------------	92	IIe-1	11	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	2
Hh	Haverson-Hysham loams, 0 to 1 percent slopes-----------------	92							
	Haverson loam----------------	--	IIs-2	11	IIIs-3	15	Silty, 10- to 14-inch precipitation zone	27	2
	Hysham loam------------------	--	IIs-2	11	IIIs-3	15	Saline Subirrigated 10- to 14-inch precipitation zone	25	--
Hl	Haverson and Lohmiller soils, 0 to 4 percent slopes----------	92	--------	--	VIw-2	16	Silty, 10- to 14-inch precipitation zone	27	2
Hm	Haverson and Lohmiller soils, channeled, 0 to 35 percent slopes------------------------	92	--------	--	VIe-1	16	Silty, 10- to 14-inch precipitation zone	27	2
Hn	Haverson loam, gravelly variant, 0 to 1 percent slopes----------	92	IIIs-2	12	--------	--	---------------------	--	3
Ho	Heldt silty clay loam, 4 to 7 percent slopes-----------------	93	--------	--	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	2
Hp	Hesper silty clay loam, 0 to 1 percent slopes-----------------	94	I-1	10	IIIc-1	15	Silty, 10- to 14-inch precipitation zone	27	2
Hr	Hesper silty clay loam, 1 to 4 percent slopes-----------------	94	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
Hs	Hilly gravelly land--------------	94	--------	--	VIe-3	16	Shallow to Gravel, 10- to 14-inch precipitation zone	28	--
Ht	Hopley loam, 4 to 7 percent slopes------------------------	95	--------	--	IIIe-4	14	Silty, 15- to 19-inch precipitation zone	27	2
Hu	Hovert clay, 0 to 1 percent slopes------------------------	95	--------	--	VIw-2	16	Overflow, 10- to 14-inch precipitation zone	26	3
Hv	Hydro-Allentine complex, 2 to 7 percent slopes-----------------	96							
	Hydro clay loam--------------	--	--------	--	IVe-5	16	Silty, 10- to 14-inch precipitation zone	27	3
	Allentine clay---------------	--	--------	--	IVe-5	16	Clayey, 10- to 14-inch precipitation zone	27	4

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
Lg	Larim gravelly loam, 0 to 4 percent slopes	101	IVe-1	12	VIe-3	16	Shallow to Gravel, 10- to 14-inch precipitation zone	28	4
Lh	Larim gravelly loam, 4 to 7 percent slopes	101	IVe-1	12	VIe-3	16	Shallow to Gravel, 10- to 14-inch precipitation zone	28	4
Ll	Larim gravelly loam, 15 to 35 percent slopes	101	--------	--	VIe-3	16	Shallow to Gravel, 10- to 14-inch precipitation zone	28	4
Lm	Lavina loam, 2 to 4 percent slopes	102	--------	--	VIe-3	16	Shallow Limy, 10- to 14-inch precipitation zone	28	4
Ln	Lismas clay, 15 to 35 percent slopes	103	--------	--	VIIs-1	17	Shale, 10- to 14-inch precipitation zone	29	--
Lo	Lohmiller silty clay loam, 3 to 7 percent slopes	103	IIIe-2	12	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	2
Lr	Lohmiller silty clay, 0 to 1 percent slopes	104	IIs-1	11	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	3
Ls	Lohmiller soils, seeped, 0 to 2 percent slopes	104	IIw-1	11	---------	--	---------------------	--	5
Lt	Lohmiller-Elso complex, 4 to 15 percent slopes	104							
	Lohmiller silty clay loam	---	---------	--	IVe-4	16	Clayey, 10- to 14-inch precipitation zone	27	2
	Elso clay loam	---	---------	--	IVe-4	16	Clayey, 10- to 14-inch precipitation zone	27	4
Lu	Lohmiller-Hysham silty clay loams, 0 to 1 percent slopes	104							
	Lohmiller silty clay loam	---	IIs-2	11	IIIs-3	15	---------------------	--	2
	Hysham silty clay loam	---	IIs-2	11	IIIs-3	15	---------------------	--	--
Lv	Lohmiller silty clay, gravelly variant, 0 to 1 percent slopes	104	IIs-1	11	IIIs-3	15	Clayey, 10- to 14-inch precipitation zone	27	3
Ma	Maginnis channery clay loam, 7 to 15 percent slopes	105	--------	--	VIIs-1	17	Shallow Nonlimy, 15- to 19-inch precipitation zone	28	--
Mc	Maginnis channery clay loam, 15 to 35 percent slopes	---	--------	--	VIIs-1	17	Shallow Nonlimy, 15- to 19-inch precipitation zone	28	--
Mg	Maginnis-Rock outcrop complex, 35 to 60 percent slopes	105	--------	--	VIIs-1	17	Shallow Nonlimy, 15- to 19-inch precipitation zone	28	--
Mk	McKenzie clay, 0 to 1 percent slopes	105	--------	--	VIw-2	16	Overflow, 10- to 14- precipitation zone	26	--
Mm	McRae loam, 0 to 1 percent slopes	106	I-1	10	IIIc-1	15	Silty, 10- to 14-inch precipitation zone	27	2

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
Mn	McRae loam, 1 to 4 percent slopes	106	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
Mo	McRae loam, 4 to 7 percent slopes	106	IIIe-2	12	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
Mr	McRae loam, 7 to 15 percent slopes	106	---------	--	IVe-4	16	Silty, 10- to 14-inch precipitation zone	27	2
Ms	McRae-Bainville loams, 7 to 15 percent slopes	106							
	McRae loam	---	---------	--	IVe-4	16	Silty, 10- to 14-inch precipitation zone	27	2
	Bainville loam	---	---------	--	IVe-4	16	Silty, 10- to 14-inch precipitation zone	27	3
Mt	McRae-Hysham loams, 0 to 1 percent slopes	107							
	McRae loam	---	IIs-2	11	IIIs-3	15	Silty, 10- to 14-inch precipitation zone	27	2
	Hysham loam	---	IIs-2	11	IIIs-3	15	Silty, 10- to 14-inch precipitation zone	27	--
Mu	McRae-Hysham loams, 1 to 3 percent slopes	107							
	McRae loam	---	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
	Hysham loam	---	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	--
Mv	McRae-Hysham loams, 3 to 6 percent slopes	107							
	McRae loam	---	IIIe-2	12	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
	Hysham loam	---	IIIe-2	12	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	--
Mw	Midway-Razor clay loams, 4 to 7 percent slopes	107							
	Midway clay loam	---	--------	--	IVe-4	16	Clayey, 10- to 14-inch precipitation zone	27	4
	Razor clay loam	---	--------	--	IVe-4	16	Clayey, 10- to 14-inch precipitation zone	27	3
My	Midway-Shale outcrop complex	107							
	Midway clay loam	---	--------	--	VIe-4	16	Thin Clayey, 10- to 14-inch precipitation zone	28	4
	Shale outcrop	---	--------	--	VIIs-3	17	Shale, 10- to 14-inch precipitation zone	29	--
Oh	Oburn-Shaak complex, 0 to 1 percent slopes	108							
	Oburn clay loam	---	--------	--	IIs-4	14	Silty, 15- to 19-inch precipitation zone	27	4
	Shaak silty clay loam	---	--------	--	IIs-4	14	Silty, 15- to 19-inch precipitation zone	27	2
Os	Oburn-Shaak complex, 1 to 4 percent slopes	108							
	Oburn clay loam	---	--------	--	IIs-4	14	Silty, 15- to 19-inch precipitation zone	27	4
	Shaak silty clay loam	---	--------	--	IIs-4	14	Silty, 15- to 19-inch precipitation zone	27	2

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
Pc	Pierre clay, 4 to 7 percent slopes	109	--------	--	IVe-5	16	Clayey, 10- to 14-inch precipitation zone	27	3
Pl	Pierre-Lismas clays, 7 to 15 percent slopes	109							
	Pierre clay	---	--------	--	VIe-4	16	Clayey, 10- to 14-inch precipitation zone	27	3
	Lismas clay	---	--------	--	VIIs-1	17	Shale, 10- to 14-inch precipitation zone	29	4
Ra	Razor clay loam, 2 to 7 percent slopes	110	--------	--	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	3
Rc	Razor-Cushman complex, 2 to 4 percent slopes	110							
	Razor clay loam	---	--------	--	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	3
	Cushman loam	---	--------	--	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	2
Re	Riverwash	110	--------	--	VIIIs-1	17	--------------------	--	--
Rk	Rock land	110	--------	--	VIIIs-1	17	--------------------	--	--
Rn	Ryegate fine sandy loam, 2 to 4 percent slopes	111	--------	--	IIIe-7	15	Sandy, 10- to 14-inch precipitation zone	26	2
Rr	Ryegate-Travessilla loams, 2 to 4 percent slopes	111							
	Ryegate loam	---	--------	--	VIe-1	16	Silty, 10- to 14-inch precipitation zone	27	2
	Travessilla loam	---	--------	--	VIe-1	16	Shallow Limy, 10- to 14-inch precipitation zone	28	4
Rt	Ryegate-Travessilla loams, 4 to 7 percent slopes	111							
	Ryegate loam	---	--------	--	VIe-1	16	Silty, 10- to 14-inch precipitation zone	27	2
	Travessilla loam	---	--------	--	VIe-1	16	Shallow Limy, 10- to 14-inch precipitation zone	28	4
Sa	Sage clay, 0 to 1 percent slopes	112	--------	--	VIIIw-2	17	--------------------	--	--
Sh	Shaak silty clay loam, 0 to 1 percent slopes	112	--------	--	IIe-2	14	Silty, 15- to 19-inch precipitation zone	27	2
Sk	Shaak silty clay loam, 1 to 4 percent slopes	112	--------	--	IIe-2	14	Silty, 15- to 19-inch precipitation zone	27	2
Sl	Shale outcrop	112	--------	--	VIIs-3	17	Shale, 10- to 14-inch precipitation zone	29	--
Sm	Shale outcrop-Midway complex, 15 to 35 percent slopes	113							
	Shale outcrop	---	--------	--	VIIs-3	17	Shale, 10- to 14-inch precipitation zone	29	--
	Midway clay loam	---	--------	--	VIe-4	16	Thin Clayey, 10- to 14-inch precipitation zone	28	4
Sn	Shonkin loam, 0 to 1 percent slopes	113	--------	--	IIIs-3	15	Overflow, 10- to 14-inch precipitation zone	26	--

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group Number
So	Shorey gravelly loam, 1 to 4 percent slopes	114	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
Sr	Shorey gravelly loam, 4 to 7 percent slopes	114	IIIe-2	12	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
Ta	Thurlow clay loam, 0 to 1 percent slopes	115	I-1	10	IIIc-1	15	Clayey, 10- to 14-inch precipitation zone	27	2
Tc	Thurlow clay loam, 4 to 7 percent slopes	115	IIIe-2	12	IIIe-5	14	Clayey, 10- to 14-inch precipitation zone	27	2
Te	Toluca clay loam, 0 to 1 percent slopes	116	I-1	10	IIIc-1	15	Silty, 10- to 14-inch precipitation zone	27	3
Th	Toluca clay loam, 1 to 4 percent slopes	116	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
Tm	Toluca clay loam, 4 to 7 percent slopes	116	IIIe-2	12	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
Tn	Toluca and Wanetta clay loams, 0 to 2 percent slopes	116	IIs-3	11	--------	--	--------------------	--	3
To	Toluca and Wanetta clay loams, 2 to 4 percent slopes	116							
	Toluca clay loam	---	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
	Wanetta clay loam	---	IIe-1	11	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	--
Tr	Travessilla sandy loam, 4 to 15 percent slopes	117	--------	--	VIe-3	16	Shallow Limy, 10- to 14-inch precipitation zone	28	4
Ts	Travessilla loam, 4 to 7 percent slopes	117	--------	--	VIe-3	16	Shallow Limy, 10- to 14-inch precipitation zone	28	4
Tt	Travessilla loam, 7 to 15 percent slopes	117	--------	--	VIe-3	16	Shallow Limy, 10- to 14-inch precipitation zone	28	4
Tu	Treasure fine sandy loam, 1 to 4 percent slopes	117	IIe-1	11	IIIe-7	15	Sandy, 10- to 14-inch precipitation zone	26	2
Tw	Treasure fine sandy loam, 4 to 10 percent slopes	117	IIIe-2	12	IIIe-7	15	Sandy, 10- to 14-inch precipitation zone	26	2
Va	Vananda silty clay, 0 to 1 percent slopes	118	IVs-1	12	VIs-1	16	Clayey, 10- to 14-inch precipitation zone	27	--
Vd	Vananda silty clay, 1 to 7 percent slopes	118	--------	--	VIs-1	16	Clayey, 10- to 14-inch precipitation zone	27	--
Ve	Vananda-Bone clays, 4 to 7 percent slopes	118							
	Vananda clay	---	--------	--	VIs-1	16	Clayey, 10- to 14-inch precipitation zone	27	--
	Bone clay	---	--------	--	VIIs-2	17	Saline Upland, 10- to 14-inch precipitation zone	28	--

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Capability unit: Dryland Symbol	Dryland Page	Range site Name	Range site Page	Windbreak suitability group[1/] Number
Wv	Wormser-Lavina clay loams, 2 to 4 percent slopes	123							
	Wormser clay loam	---	--------	--	IIIe-5	14	Silty, 10- to 14-inch precipitation zone	27	3
	Lavina clay loam	---	--------	--	IIIe-5	14	Shallow Limy, 10- to 14-inch precipitation zone	28	3
Ww	Wormser-Worland sandy loams, 4 to 7 percent slopes	123							
	Wormser sandy loam	---	--------	--	IIIe-7	15	Sandy, 10- to 14-inch precipitation zone	26	3
	Worland sandy loam	---	--------	--	IIIe-7	15	Sandy, 10- to 14-inch precipitation zone	26	--
Ya	Yegen sandy loam, 0 to 1 percent slopes	124	I-1	10	IIIe-6	15	Sandy, 15- to 19-inch precipitation zone	26	1
Yd	Yegen sandy loam, 1 to 4 percent slopes	124	IIe-1	11	IIIe-6	15	Sandy, 15- to 19-inch precipitation zone	26	1
Ye	Yegen sandy loam, 4 to 10 percent slopes	124	IIIe-2	12	IIIe-6	15	Sandy, 15- to 19-inch precipitation zone	26	1
Yt	Yegen and Toluca soils, 7 to 15 percent slopes	124							
	Yegen sandy loam	---	---------	--	IVe-4	16	Sandy, 10- to 14-inch precipitation zone	26	1
	Toluca clay loam	---	---------	--	IVe-4	16	Silty, 10- to 14-inch precipitation zone	27	3

1/ Soils not placed in woodland suitability groups 1 through 5 are not suitable for windbreak plantings.

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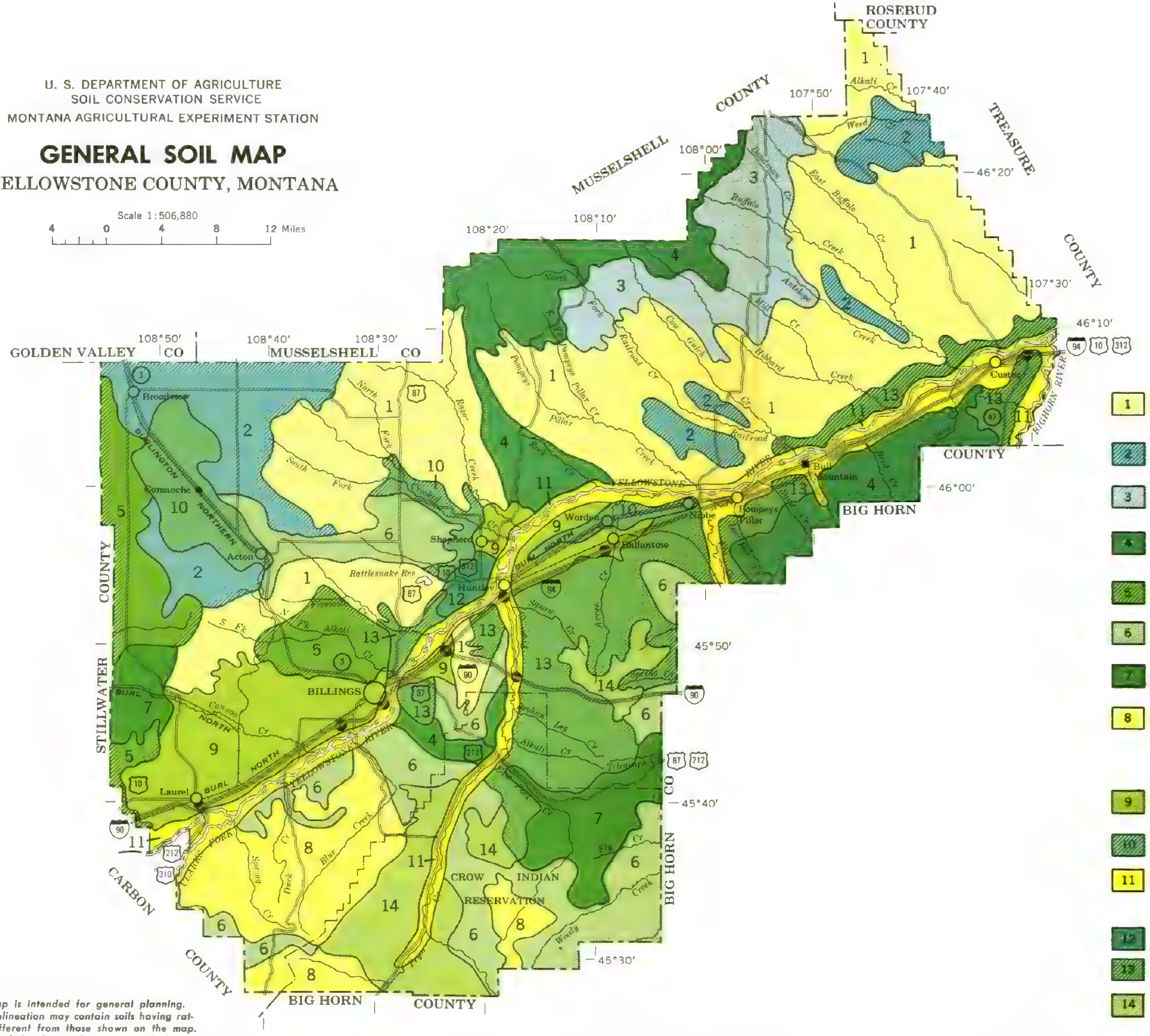
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MONTANA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

YELLOWSTONE COUNTY, MONTANA

Scale 1:506,880

4 0 4 8 12 Miles



NOTE—
This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning.

SOIL ASSOCIATIONS

SOILS OF THE SHALE AND SANDSTONE UPLANDS

1 Bainville-Elso-McRae association: Undulating to hilly, moderately deep and shallow loams and clay loams underlain by silt loam to silty clay loam, and deep soils that are loam throughout; on shale and sandstone uplands

2 Cushman-Bainville association: Undulating to rolling, moderately deep loams that have a clay loam subsoil or are underlain by clay loam and silt loam; on shale uplands

3 Worland-Bainville-Travessilla association: Rolling to hilly, moderately deep and shallow fine sandy loams and loams underlain by sandy loam to clay loam; on sandstone and shale uplands

4 Bainville-Travessilla-Rock land association: Moderately steep and steep, moderately deep and shallow loams and fine sandy loams underlain by clay loam to fine sandy loam, and sandstone and shale rock land

5 Wormser-Lavina-Razor association: Undulating to rolling, moderately deep and shallow soils that have a dominantly clay loam subsoil; on sandstone and shale uplands

6 Pierre-Lismas-Kyle association: Rolling to moderately steep, shallow to deep silty clays and clays that are underlain by clay; on clay shale uplands

7 Midway-Heldt association: Sloping to moderately steep, moderately deep and deep soils that are dominantly clay loam and silty clay loam throughout; on uplands and in valleys

8 Maginnis-Absarokee association: Undulating to steep, shallow and moderately deep soils that have a dominantly clay loam subsoil; on uplands

SOILS OF THE RIVER TERRACES, LOW ALLUVIAL FANS, AND FLOOD PLAINS

9 McRae-Lohmiller-Keiser association: Gently sloping to sloping, deep loams to silty clays underlain by clay to fine sandy loam; on high terraces and fans

10 Vananda-McKenzie-Arvada association: Level to gently sloping, deep clays to loams over clay; on terraces and fans and in dry lake basins

11 Haverson association: Level to gently sloping, deep loams that are underlain by loam and silt loam; on flood plains and terraces

SOILS OF THE HIGH TERRACES AND BENCHES

12 Bew-Allentine association: Level to sloping, deep soils that have a clay subsoil; on terraces and fans

13 Wanetta-Keiser association: Level to steep, deep soils that have a clay loam to silty clay subsoil; on high terraces

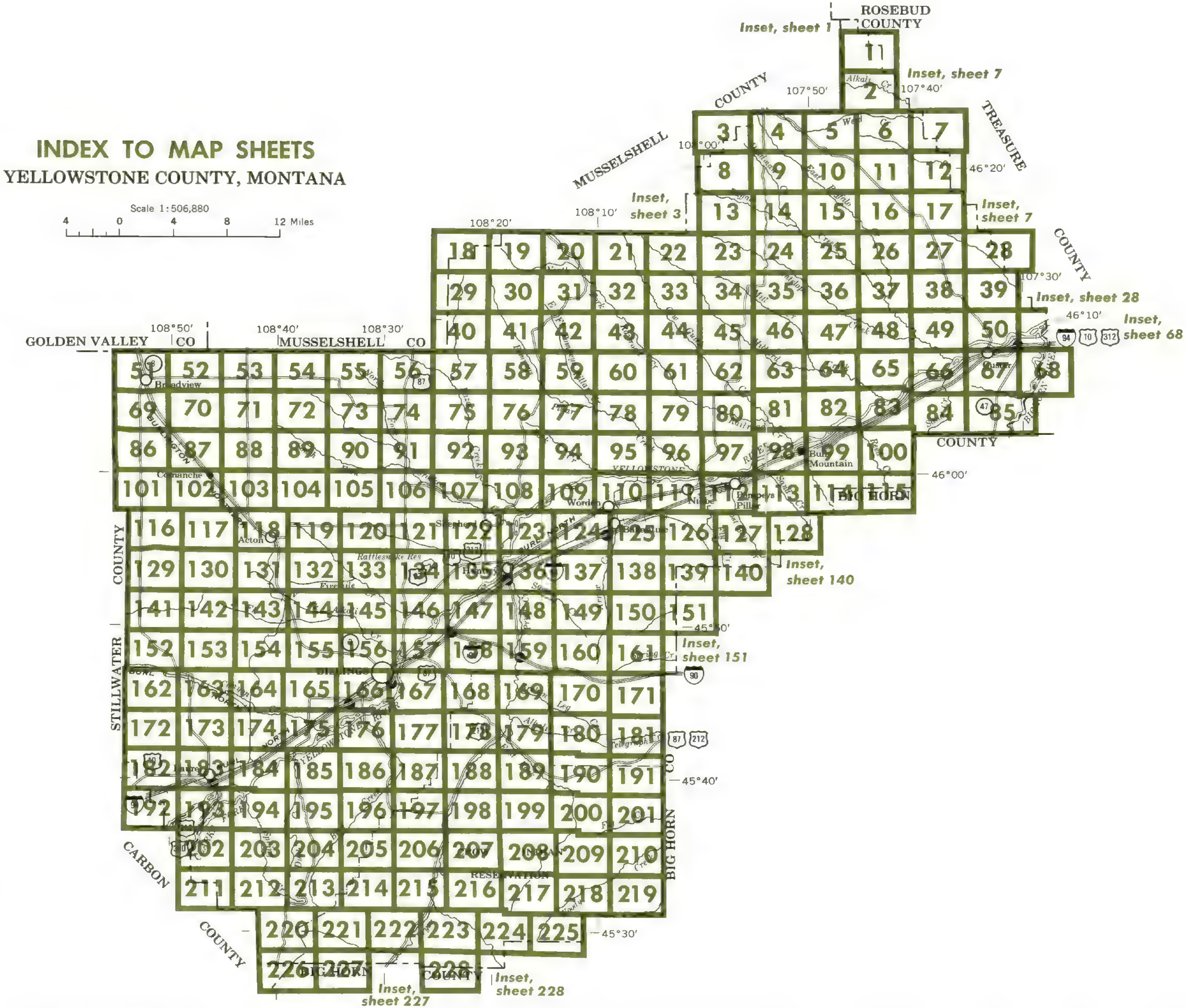
14 Danvers association: Gently undulating to rolling, deep soils that have a silty clay and clay loam subsoil; on high benches

December 1970

INDEX TO MAP SHEETS

YELLOWSTONE COUNTY, MONTANA

Scale 1:506,880



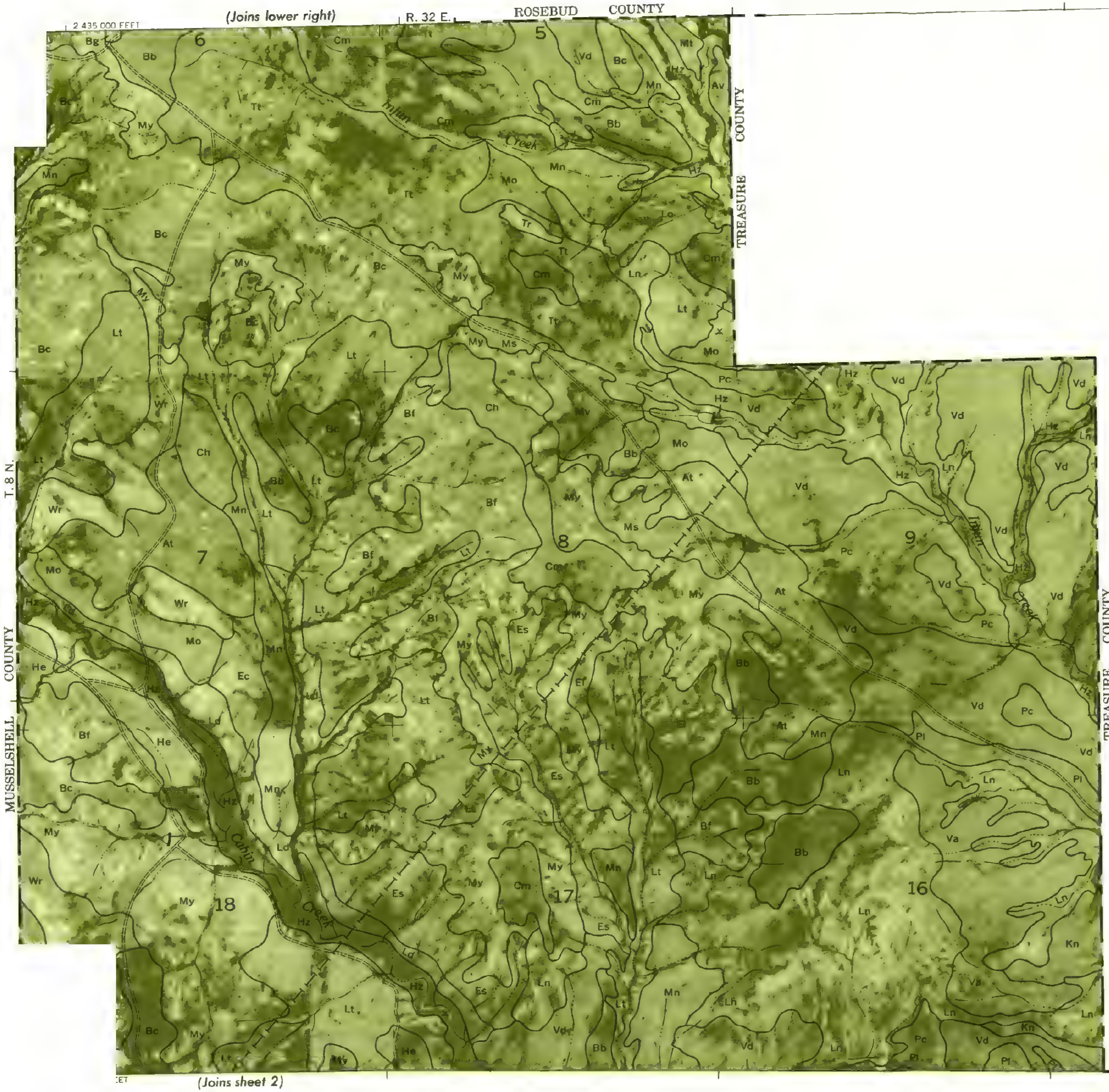
SOIL LEGEND

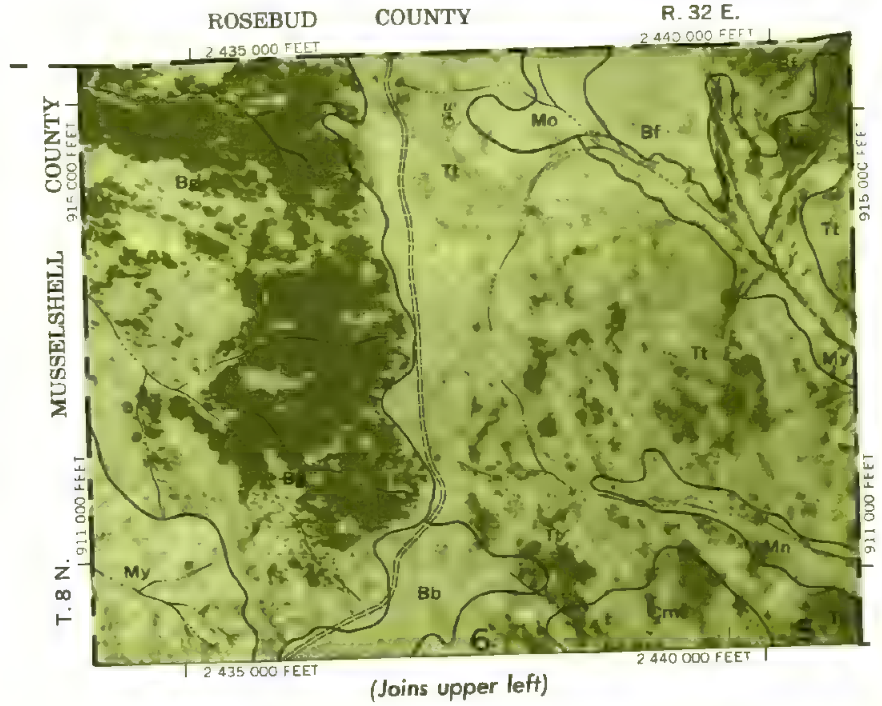
SYMBOL	NAME
Aa	Absarokee clay loam, 1 to 4 percent slopes
Ab	Absarokee clay loam, 4 to 7 percent slopes
Ag	Alluvial land, gravelly
Al	Alluvial land, mixed
Am	Alluvial land, seeped
An	Alluvial land, wet
Ao	Amherst clay loam, 7 to 15 percent slopes
Ap	Amherst-Maginnis channery clay looms, 4 to 7 percent slopes
Ar	Apron loamy fine sand, 4 to 7 percent slopes
As	Apron fine sandy loam, 4 to 7 percent slopes
At	Apron-Travessilla loamy fine sands, 7 to 15 percent slopes
Au	Arvada clay loam, 0 to 1 percent slopes
Av	Arvada clay loam, 1 to 4 percent slopes
Aw	Arvada clay loam, 4 to 7 percent slopes
Ax	Arvada-Bone silty clay loams, 0 to 1 percent slopes
Ay	Arvada-Bone clays, 0 to 1 percent slopes
Bb	Bainville loam, 2 to 7 percent slopes
Bc	Bainville loam, 7 to 15 percent slopes
Be	Bainville-Elso complex, 15 to 35 percent slopes
Bf	Bainville-Elso-Shale outcrop complex, 7 to 25 percent slopes
Bg	Bainville-Rock outcrop complex, 15 to 45 percent slopes
Bl	Bainville-Worland complex, 4 to 7 percent slopes
Bm	Bew silty clay loam, 0 to 1 percent slopes
Bn	Bew clay, 0 to 1 percent slopes
Bo	Bew clay, 1 to 4 percent slopes
Br	Bew-Allentine clays, 0 to 1 percent slopes
Bs	Big Horn clay loam, 0 to 2 percent slopes
Bt	Bone silty clay, 0 to 1 percent slopes
Bu	Bone silty clay, 1 to 6 percent slopes
Bv	Bone clay, 0 to 1 percent slopes
Ca	Clapper clay loam, 15 to 35 percent slopes
Cg	Clapper gravelly loam, 7 to 15 percent slopes
Ch	Cushman-Bainville loams, 1 to 4 percent slopes
Cm	Cushman-Bainville loams, 4 to 7 percent slopes
Da	Danvers silty clay loam, 2 to 4 percent slopes
Dn	Danvers silty clay loam, 8 to 15 percent slopes
Dr	Danvers-Judith complex, 7 to 15 percent slopes
Ds	Danvers-Shaak clay loams, 7 to 15 percent slopes
Ec	Elso clay loam, 4 to 7 percent slopes
El	Elso clay loam, 7 to 15 percent slopes
Eo	Elso clay loam, 15 to 60 percent slopes
Es	Elso-Lohmiller complex, 15 to 35 percent slopes
Fa	Farland-Lambert silt loams, 0 to 4 percent slopes
Fg	Fattig sandy clay loam, 4 to 7 percent slopes
Fl	Fort Collins-Arvada clay loams, 0 to 1 percent slopes
Fo	Fort Collins-Arvada clay loams, 1 to 4 percent slopes
Fr	Fort Collins and Thurlow clay loams, 0 to 1 percent slopes
Ft	Fort Collins and Thurlow clay loams, 1 to 4 percent slopes
Ga	Gilt Edge-Allentine complex, 2 to 7 percent slopes
Gh	Glenberg fine sandy loam, 1 to 4 percent slopes
Gl	Glenberg loam, 0 to 1 percent slopes
Go	Glenberg loam, gravelly substratum, 0 to 1 percent slopes
Gr	Grail clay loam, 2 to 4 percent slopes
Gs	Grail silty clay, 0 to 1 percent slopes
Gt	Grail soils, 2 to 15 percent slopes
Ha	Haverson loam, 0 to 1 percent slopes
Hb	Haverson loam, clay substratum, 0 to 1 percent slopes
Hc	Haverson clay loam, 0 to 1 percent slopes
Hd	Haverson silty clay loam, 0 to 1 percent slopes
He	Haverson silty clay loam, 1 to 3 percent slopes
Hh	Haverson-Hysham loams, 0 to 1 percent slopes
Hl	Haverson and Lohmiller soils, 0 to 4 percent slopes
Hm	Haverson and Lohmiller soils, channeled, 0 to 35 percent slopes
Hn	Haverson loam, gravelly variant, 0 to 1 percent slopes
Ho	Heldt silty clay loam, 4 to 7 percent slopes
Hp	Hesper silty clay loam, 0 to 1 percent slopes
Hr	Hesper silty clay loam, 1 to 4 percent slopes
Hs	Hilly gravelly land
Ht	Hopley loam, 4 to 7 percent slopes
Hu	Hovert clay, 0 to 1 percent slopes
Hv	Hydro-Allentine complex, 2 to 7 percent slopes
Hw	Hydro-Arvada clay loams, 0 to 2 percent slopes
Hx	Hysham-Laurel loams, 0 to 2 percent slopes
Hy	Hysham-Laurel silty clay loams, 0 to 2 percent slopes
Hz	Hysham and Haverson soils, 0 to 4 percent slopes
Kc	Keiser silty clay loam, 0 to 1 percent slopes
Ke	Keiser silty clay loam, 1 to 4 percent slopes
Kg	Keiser silty clay loam, 4 to 7 percent slopes
Kh	Keiser and Hesper silty clay loams, 0 to 1 percent slopes
Kl	Kyle silty clay, 0 to 1 percent slopes
Km	Kyle silty clay, 1 to 4 percent slopes
Kn	Kyle silty clay, 4 to 7 percent slopes
La	Lambert silt loam, 1 to 4 percent slopes
Lb	Lambert silt loam, 4 to 7 percent slopes
Lc	Lambert silt loam, 7 to 15 percent slopes
Ld	Lambert soils, 7 to 35 percent slopes
Le	Larim loam, 0 to 4 percent slopes
Lg	Larim gravelly loam, 0 to 4 percent slopes
Lh	Larim gravelly loam, 4 to 7 percent slopes
Ll	Larim gravelly loam, 15 to 35 percent slopes
Lm	Lavina loam, 2 to 4 percent slopes
Ln	Lismas clay, 15 to 35 percent slopes
Lo	Lohmiller silty clay loam, 3 to 7 percent slopes
Lr	Lohmiller silty clay, 0 to 1 percent slopes
Ls	Lohmiller soils, seeped, 0 to 2 percent slopes
Lt	Lohmiller-Elso complex, 4 to 15 percent slopes
Lu	Lohmiller-Hysham silty clay loams, 0 to 1 percent slopes
Lv	Lohmiller silty clay, gravelly variant, 0 to 1 percent slopes
Ma	Maginnis channery clay loam, 7 to 15 percent slopes
Mc	Maginnis channery clay loam, 15 to 35 percent slopes
Mg	Maginnis-Rock outcrop complex, 35 to 60 percent slopes
Mk	McKenzie clay, 0 to 1 percent slopes
Mm	McRae loam, 0 to 1 percent slopes
Mn	McRae loam, 1 to 4 percent slopes
Mo	McRae loam, 4 to 7 percent slopes
Mr	McRae loam, 7 to 15 percent slopes
Ms	McRae-Bainville loams, 7 to 15 percent slopes
Mt	McRae-Hysham loams, 0 to 1 percent slopes
Mu	McRae-Hysham loams, 1 to 3 percent slopes
Mv	McRae-Hysham loams, 3 to 6 percent slopes
Mw	Midway-Razor clay loams, 4 to 7 percent slopes
My	Midway-Shale outcrop complex
Oh	Oburn-Shaak complex, 0 to 1 percent slopes
Os	Oburn-Shaak complex, 1 to 4 percent slopes
Pc	Pierre clay, 4 to 7 percent slopes
Pl	Pierre-Lismas clays, 7 to 15 percent slopes
Ra	Razor clay loam, 2 to 7 percent slopes
Rc	Razor-Cushman complex, 2 to 4 percent slopes
Re	Riverwash
Rk	Rock land
Rn	Ryegate fine sandy loam, 2 to 4 percent slopes
Rr	Ryegate-Travessilla loams, 2 to 4 percent slopes
Rt	Ryegate-Travessilla loams, 4 to 7 percent slopes
Sa	Sage clay, 0 to 1 percent slopes
Sh	Shaak silty clay loam, 0 to 1 percent slopes
Sk	Shaak silty clay loam, 1 to 4 percent slopes
Sl	Shale outcrop
Sm	Shale outcrop-Midway complex, 15 to 35 percent slopes
Sn	Shonkin loam, 0 to 1 percent slopes
So	Shorey gravelly loam, 1 to 4 percent slopes
Sr	Shorey gravelly loam, 4 to 7 percent slopes
Ta	Thurlow clay loam, 0 to 1 percent slopes
Tc	Thurlow clay loam, 4 to 7 percent slopes
Te	Toluca clay loam, 0 to 1 percent slopes
Th	Toluca clay loam, 1 to 4 percent slopes
Tm	Toluca clay loam, 4 to 7 percent slopes
Tn	Toluca and Wanetta clay loams, 0 to 2 percent slopes
To	Toluca and Wanetta clay loams, 2 to 4 percent slopes
Tr	Travessilla sandy loam, 4 to 15 percent slopes
Ts	Travessilla loam, 4 to 7 percent slopes
Tt	Travessilla loam, 7 to 15 percent slopes
Tu	Treasure fine sandy loam, 1 to 4 percent slopes
Tw	Treasure fine sandy loam, 4 to 10 percent slopes
Va	Vananda silty clay, 0 to 1 percent slopes
Vd	Vananda silty clay, 1 to 7 percent slopes
Ve	Vananda-Bone clays, 4 to 7 percent slopes
Wa	Wanetta loam, 0 to 1 percent slopes
Wc	Wanetta loam, 1 to 4 percent slopes
We	Wanetta gravelly loam, 0 to 2 percent slopes
Wf	Wanetta clay loam, 0 to 1 percent slopes
Wg	Wanetta clay loam, 1 to 4 percent slopes
Wh	Wanetta-Larim clay loams, 0 to 1 percent slopes
Wk	Wanetta-Larim clay loams, 1 to 4 percent slopes
Wl	Wanetta-Larim clay loams, 4 to 7 percent slopes
Wm	Work clay loam, 1 to 4 percent slopes
Wn	Work clay loam, 4 to 7 percent slopes
Wo	Worland fine sandy loam, 2 to 7 percent slopes
Wr	Worland-Travessilla fine sandy loams, 7 to 15 percent slopes
Ws	Wormser clay loam, 1 to 4 percent slopes
Wt	Wormser clay loam, 4 to 7 percent slopes
Wv	Wormser-Lavina clay loams, 2 to 4 percent slopes
Ww	Wormser-Worland sandy loams, 4 to 7 percent slopes
Ya	Yegen sandy loam, 0 to 1 percent slopes
Yd	Yegen sandy loam, 1 to 4 percent slopes
Ye	Yegen sandy loam, 4 to 10 percent slopes
Yt	Yegen and Toluca soils, 7 to 15 percent slopes

Soil map constructed 1969 by Cartographic Division, Soil Conservation Service, USDA, from 1957 aerial photographs. Controlled mosaic based on Montana plane coordinate system, south zone, Lambert conformal conic projection, 1927 North American datum.

1

N





GRID TICK INTERVAL 4000 FEET ON NORTH-SOUTH LINE

Scale 1:20 000

1 Mile ¾ ½ ¼ 0

5000 Feet 4000 3000 2000 1000 0

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 1

...rial photographs. 5,000-foot
...ana plane coordinate
...7 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 10

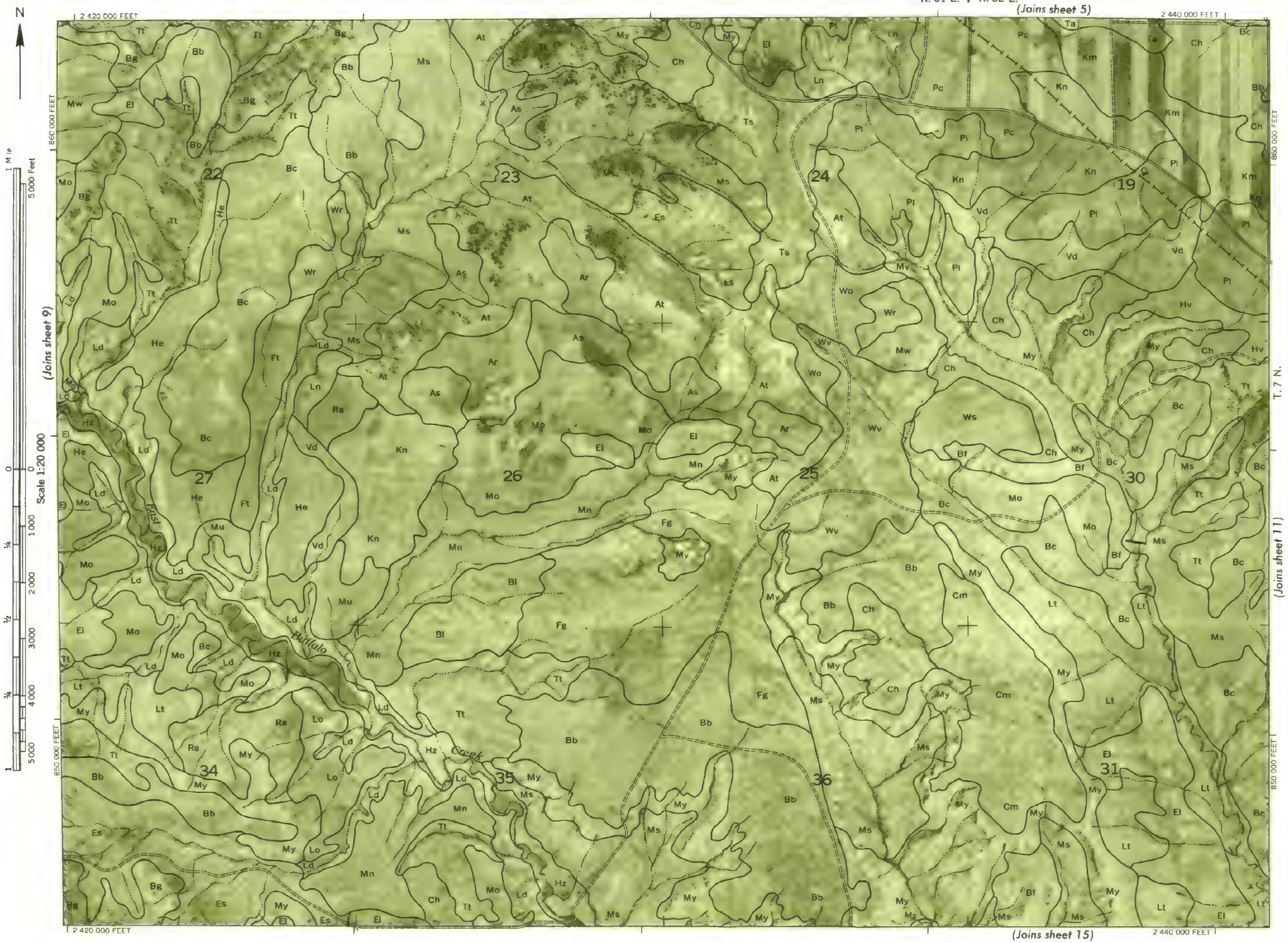


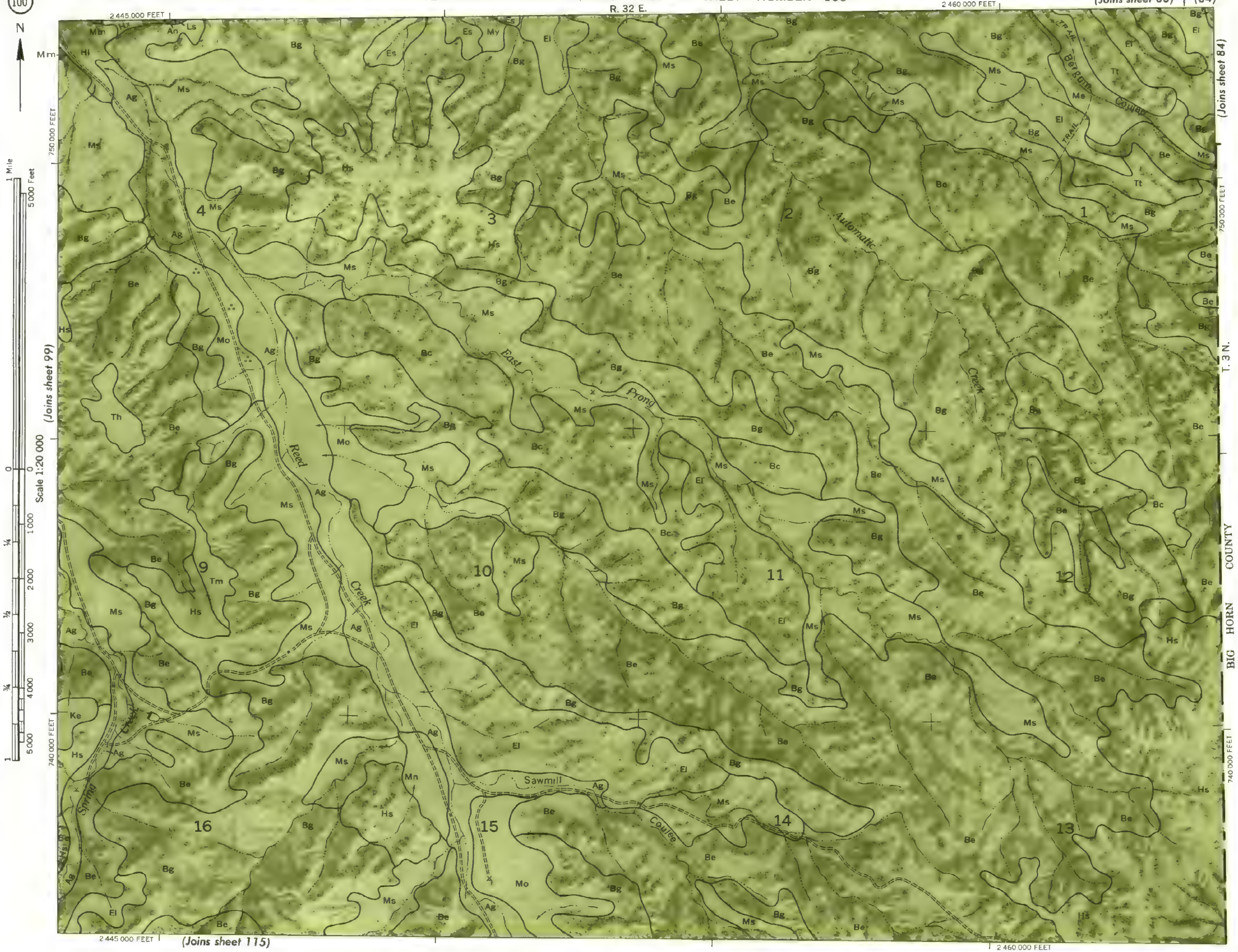
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 10

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 100



YELLOWSTONE COUNTY, MONTANA NO. 100

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

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Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 101

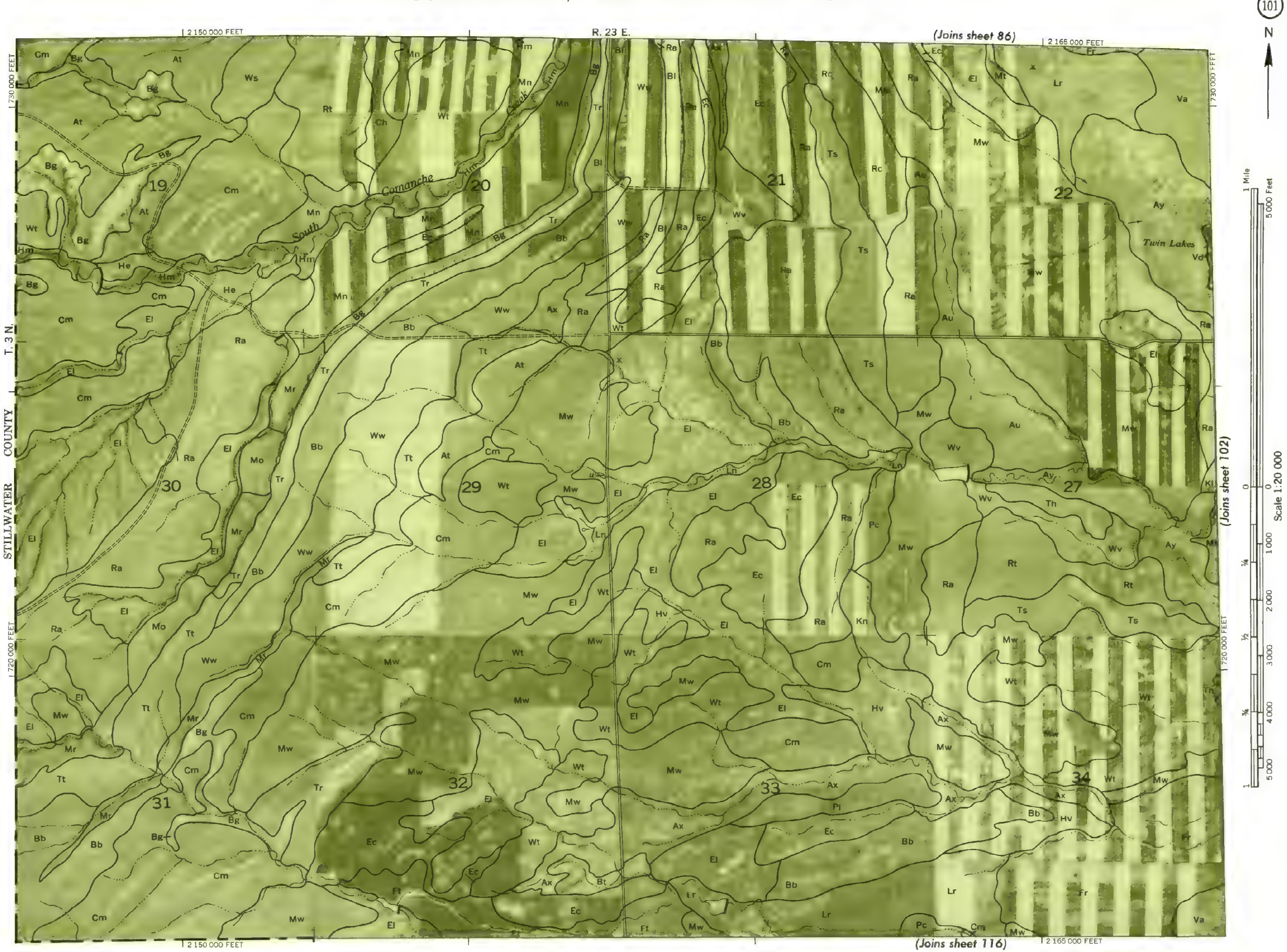
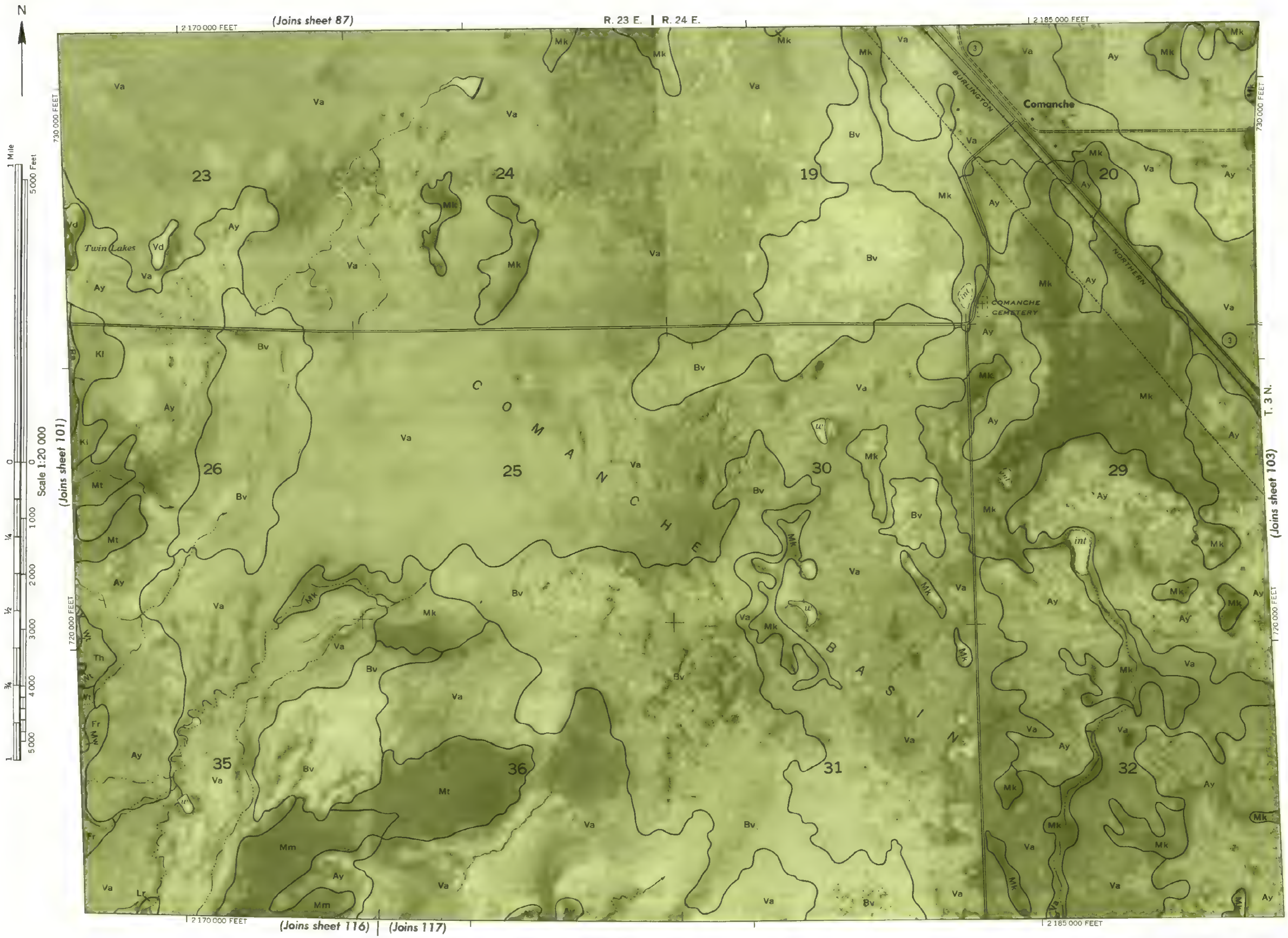


Photo base from 1957 aerial photographs 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 102



YELLOWSTONE COUNTY, MONTANA NO. 102

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs 5,000 foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

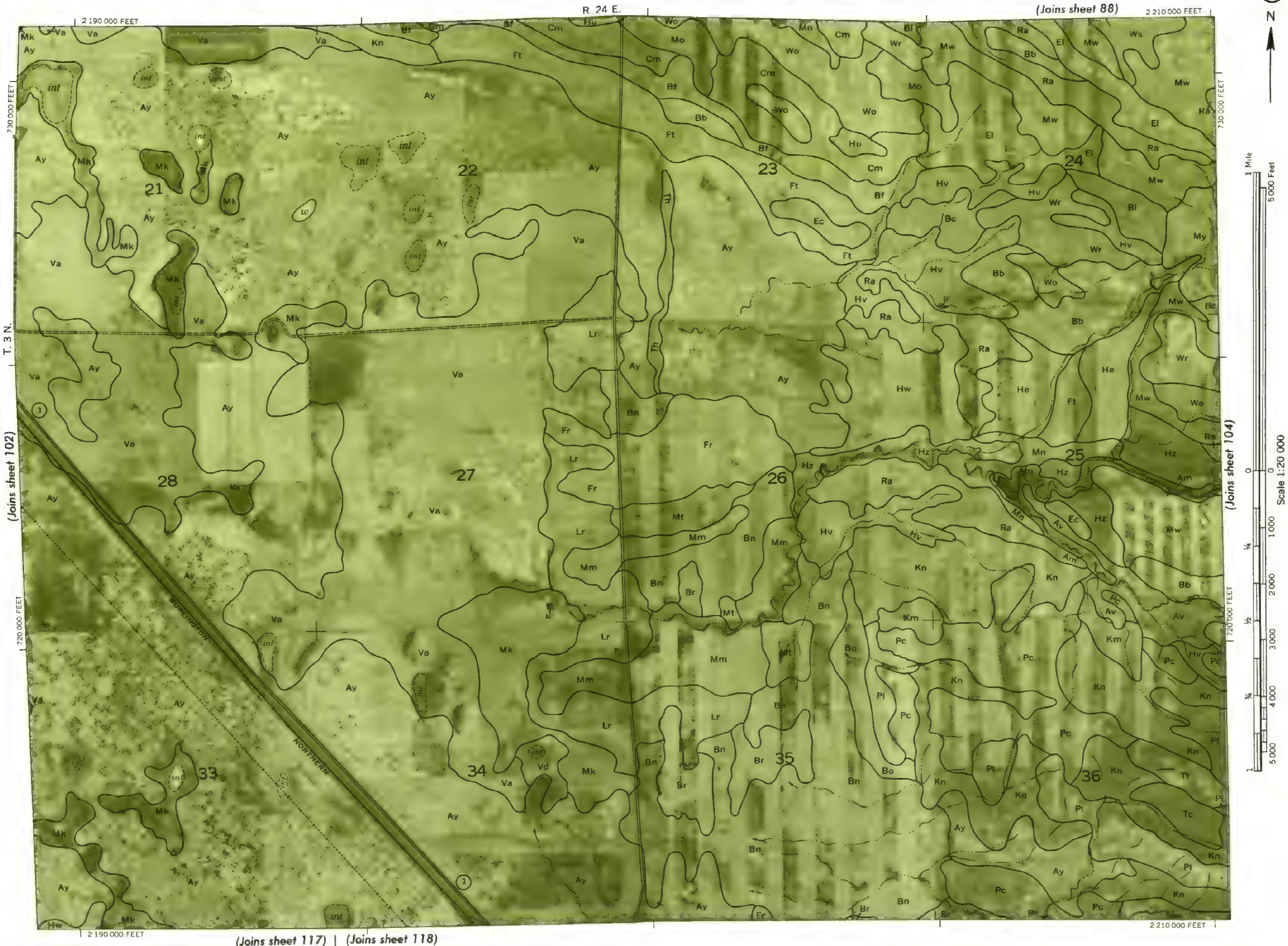


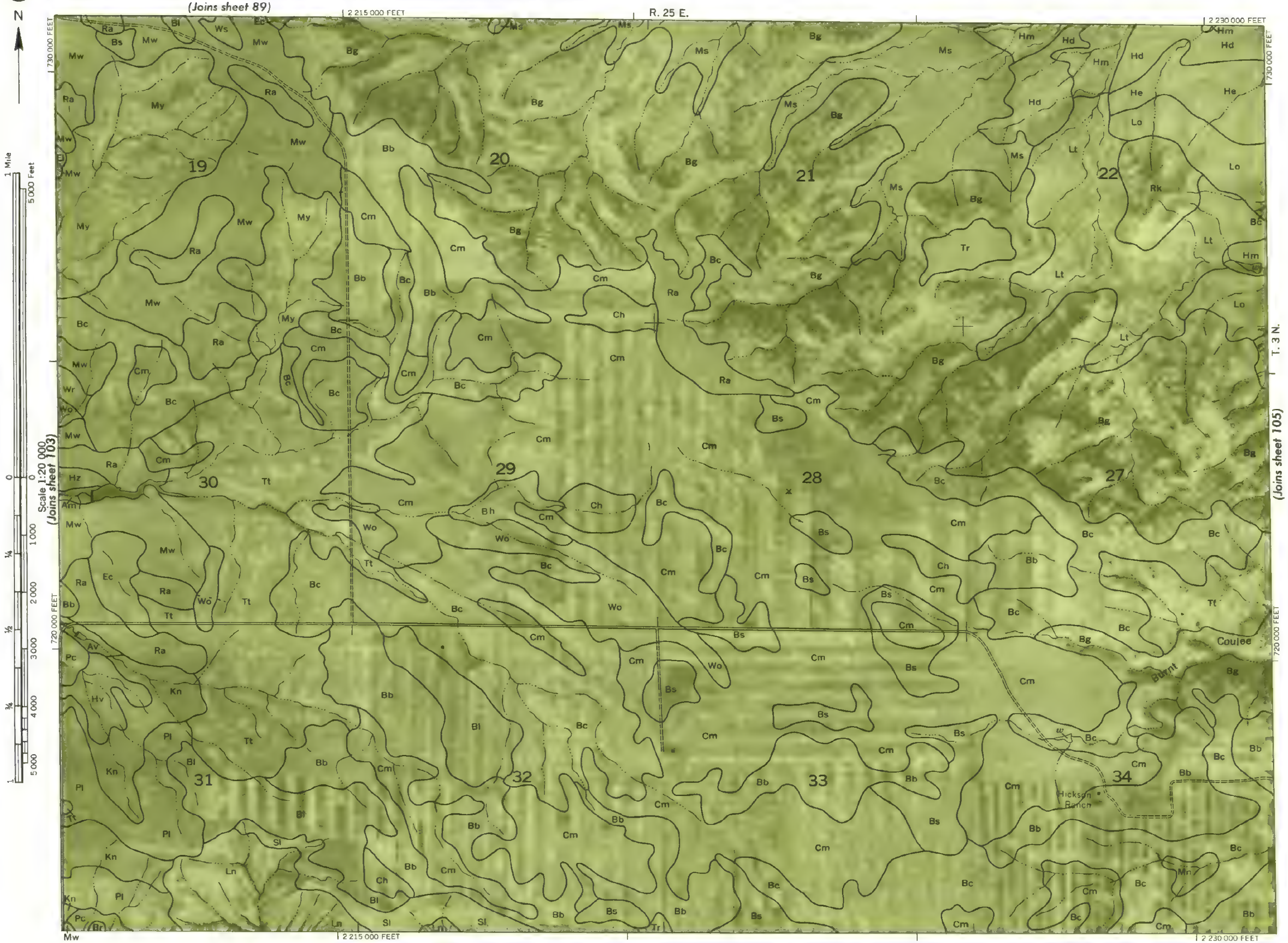
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 104

(Joins sheet 89)



(Joins sheet 118) | (Joins sheet 119)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 104

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

105

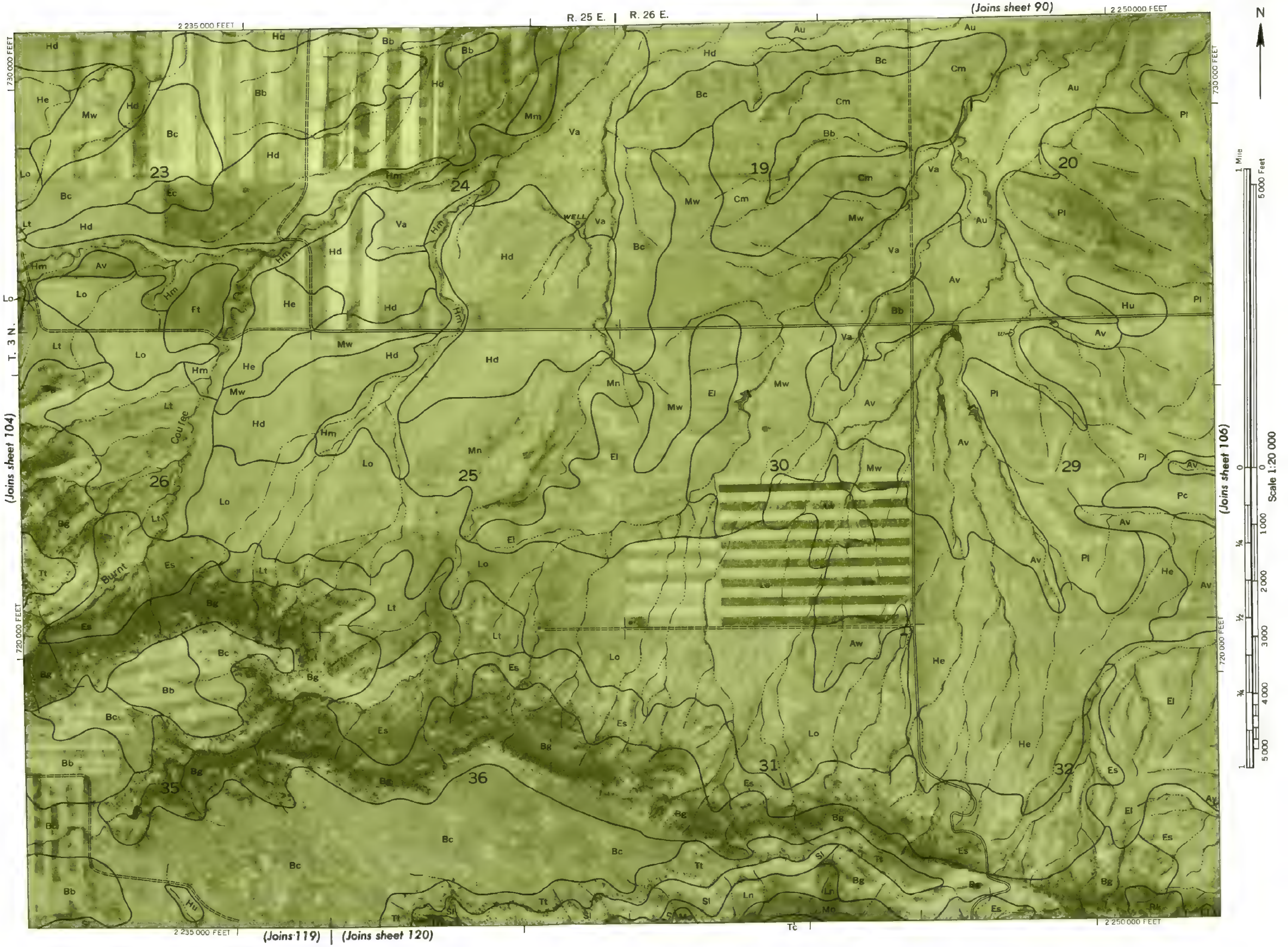


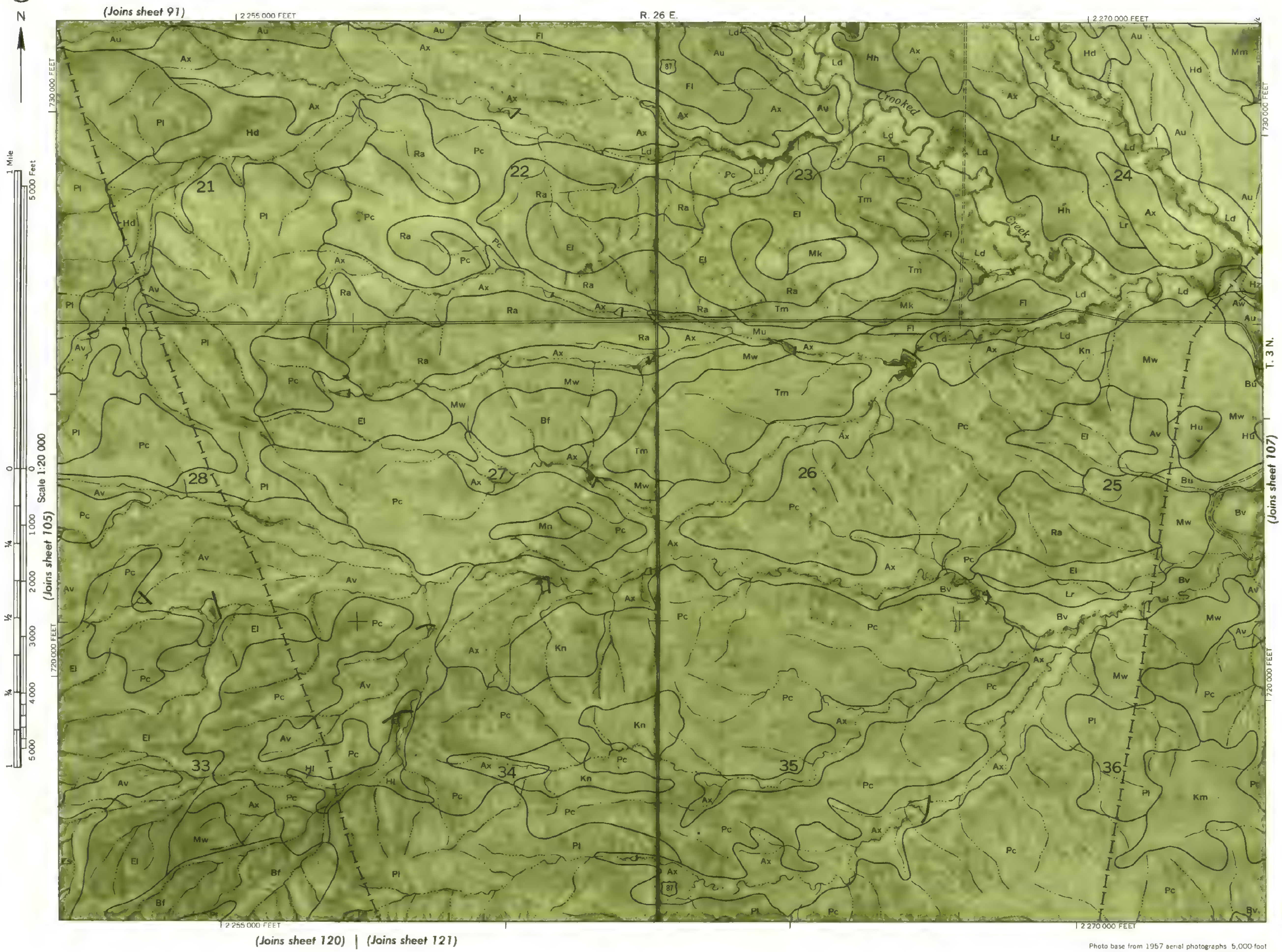
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 105

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 106



YELLOWSTONE COUNTY, MONTANA NO. 106

Land division corners are approx mately positioned on th s map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricu tural Experiment Station

Photo base from 1957 aerial photographs 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

107

N

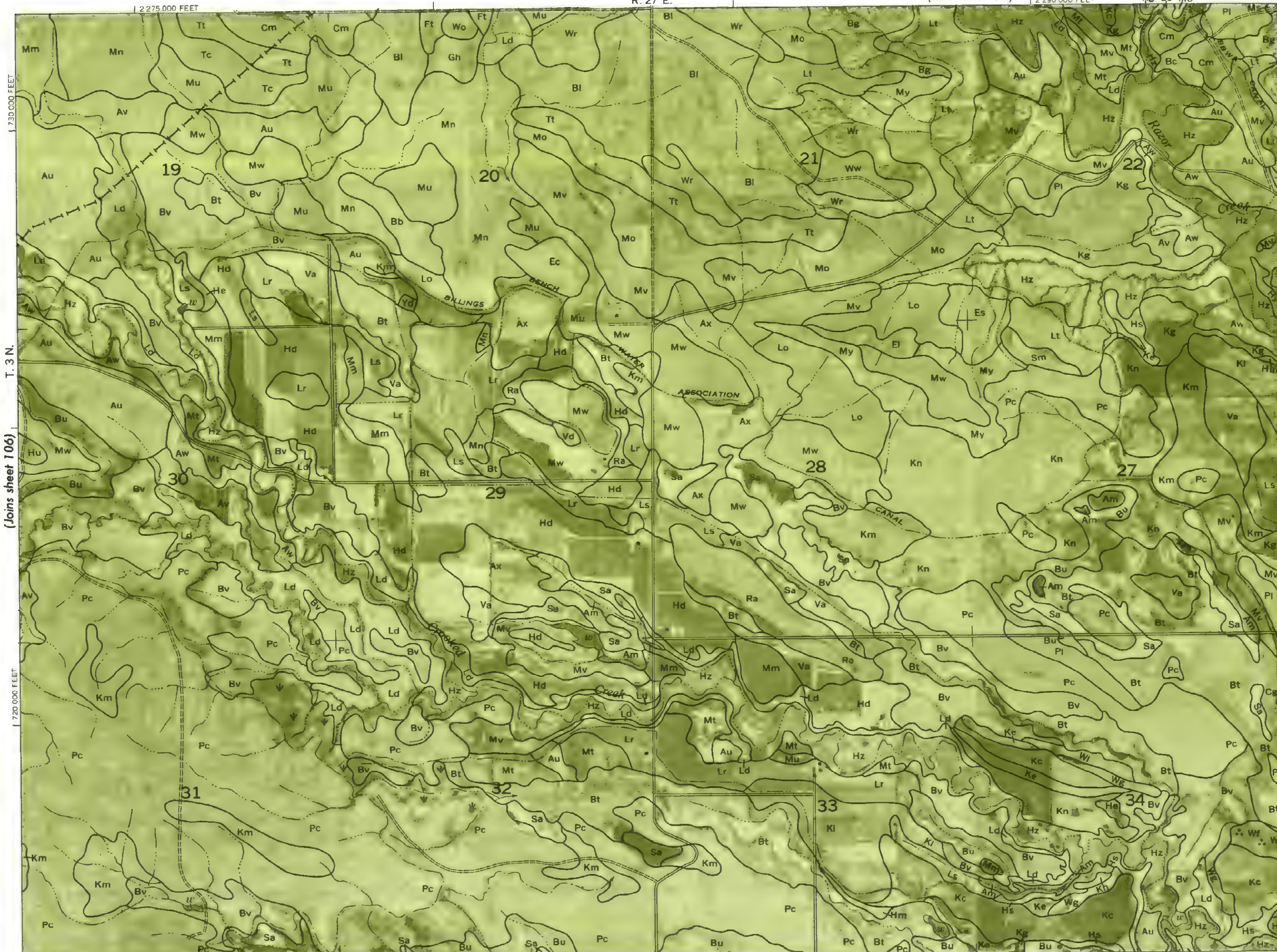
(Joins sheet 92)

R. 27 E.

T. 3 N.

(Joins sheet 106)

(Joins sheet 108)



1 Mile
5000 Feet
Scale 1:20 000

(Joins sheet 121) | (Joins 122)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 108

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 108

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 109

109

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA NO. 109

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

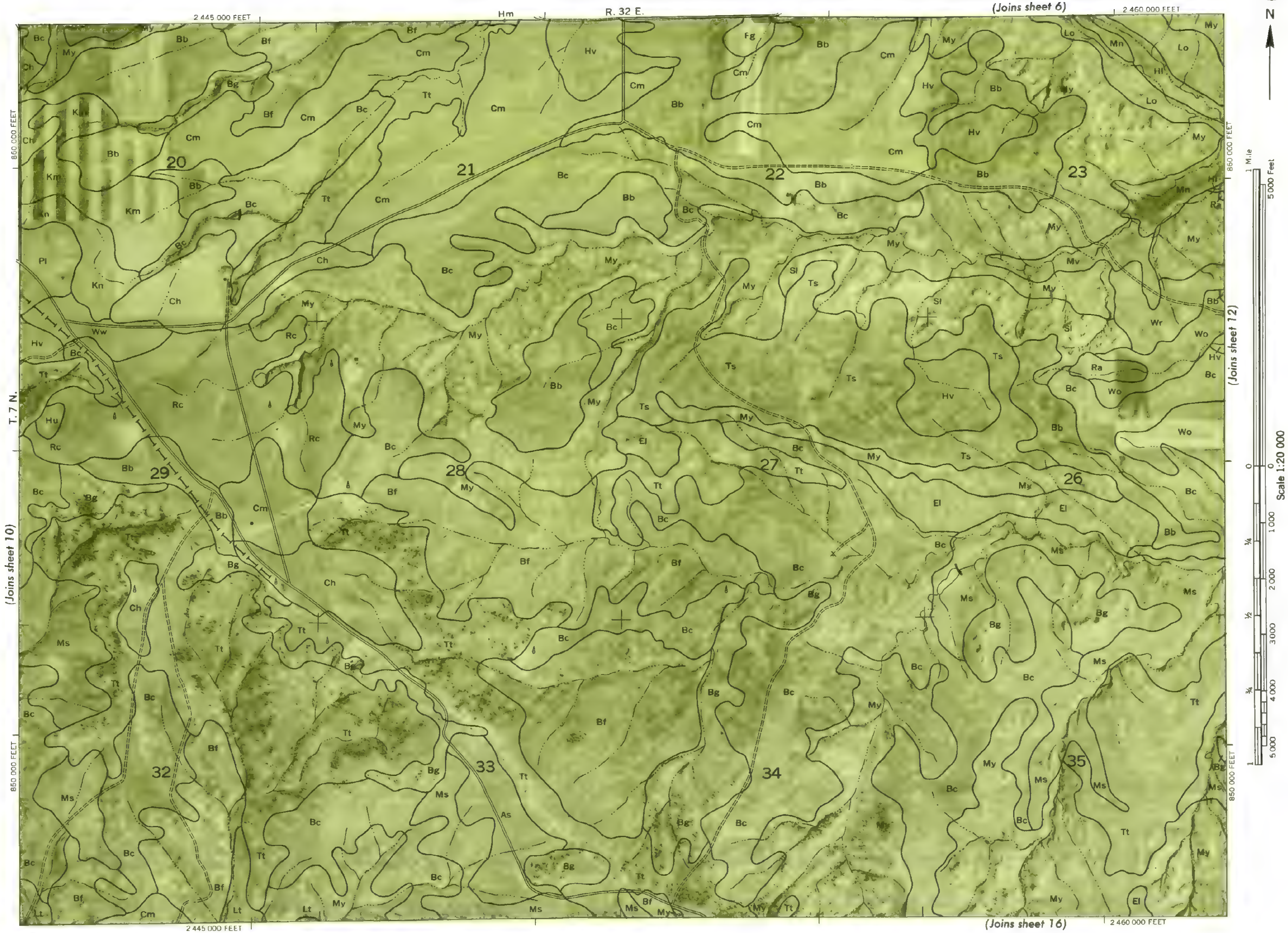
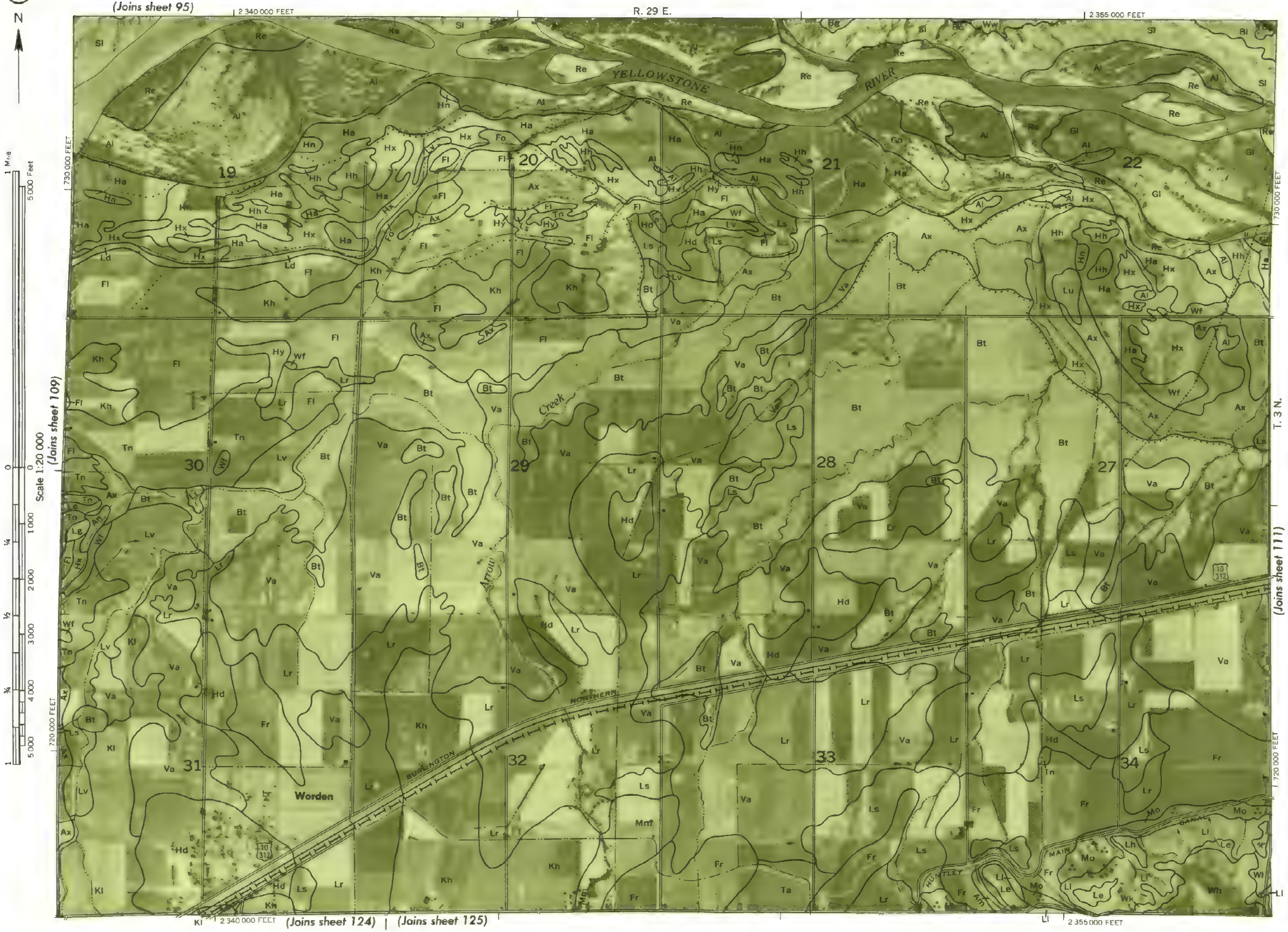


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 110



YELLOWSTONE COUNTY, MONTANA NO. 110

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

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Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 111

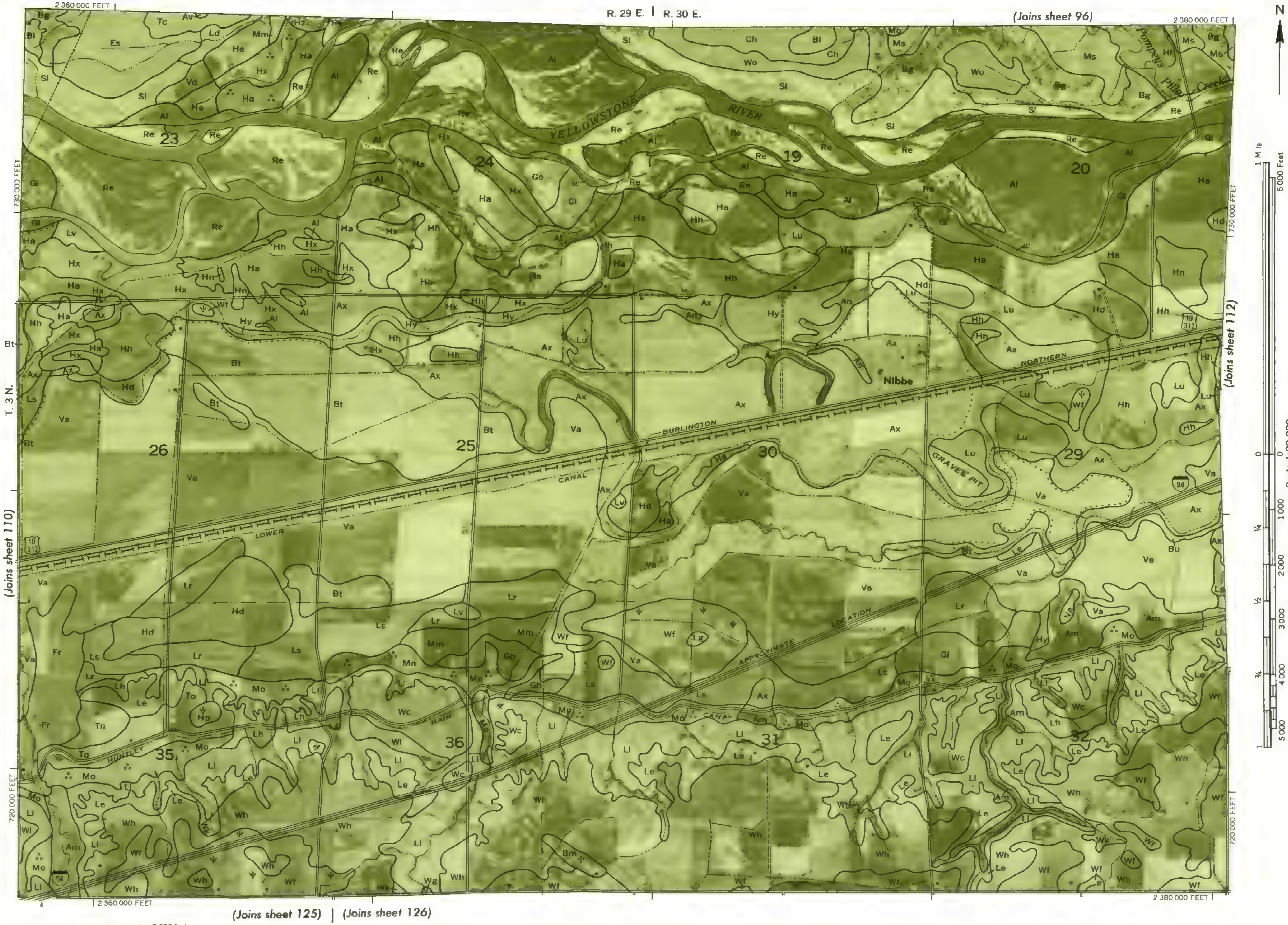

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 112

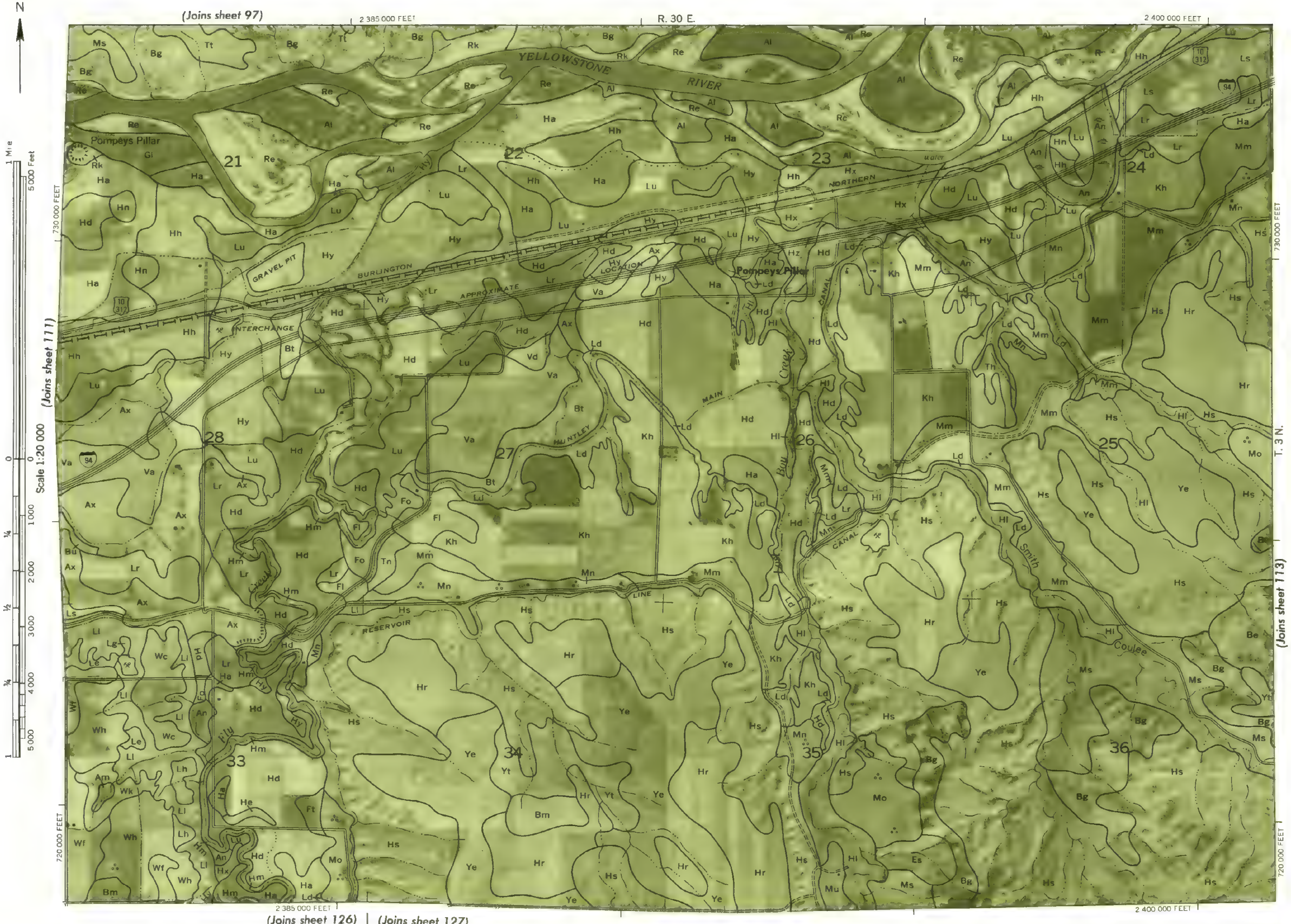

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 112

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

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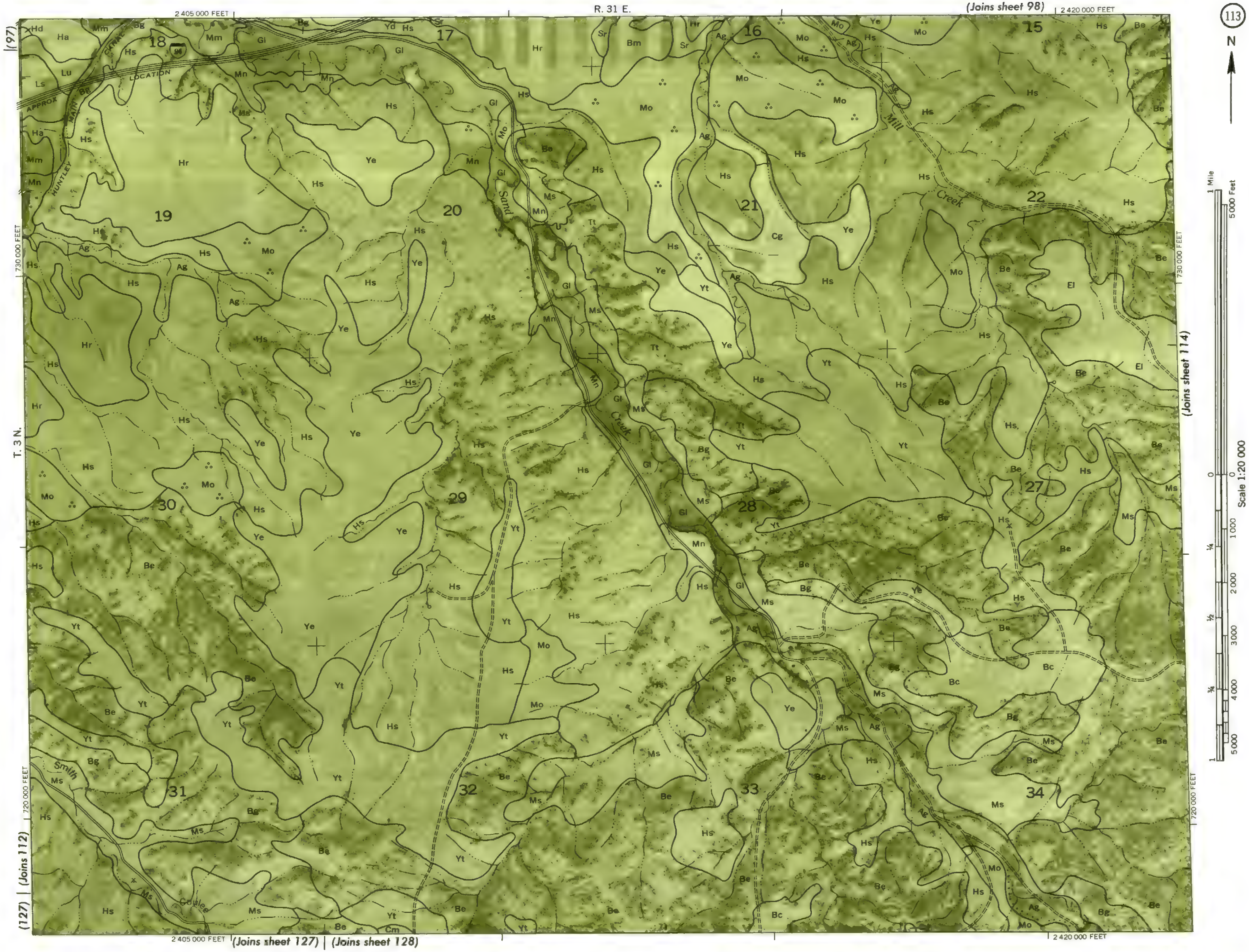
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 113

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 113



YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 114

YELLOWSTONE COUNTY, MONTANA NO. 114

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

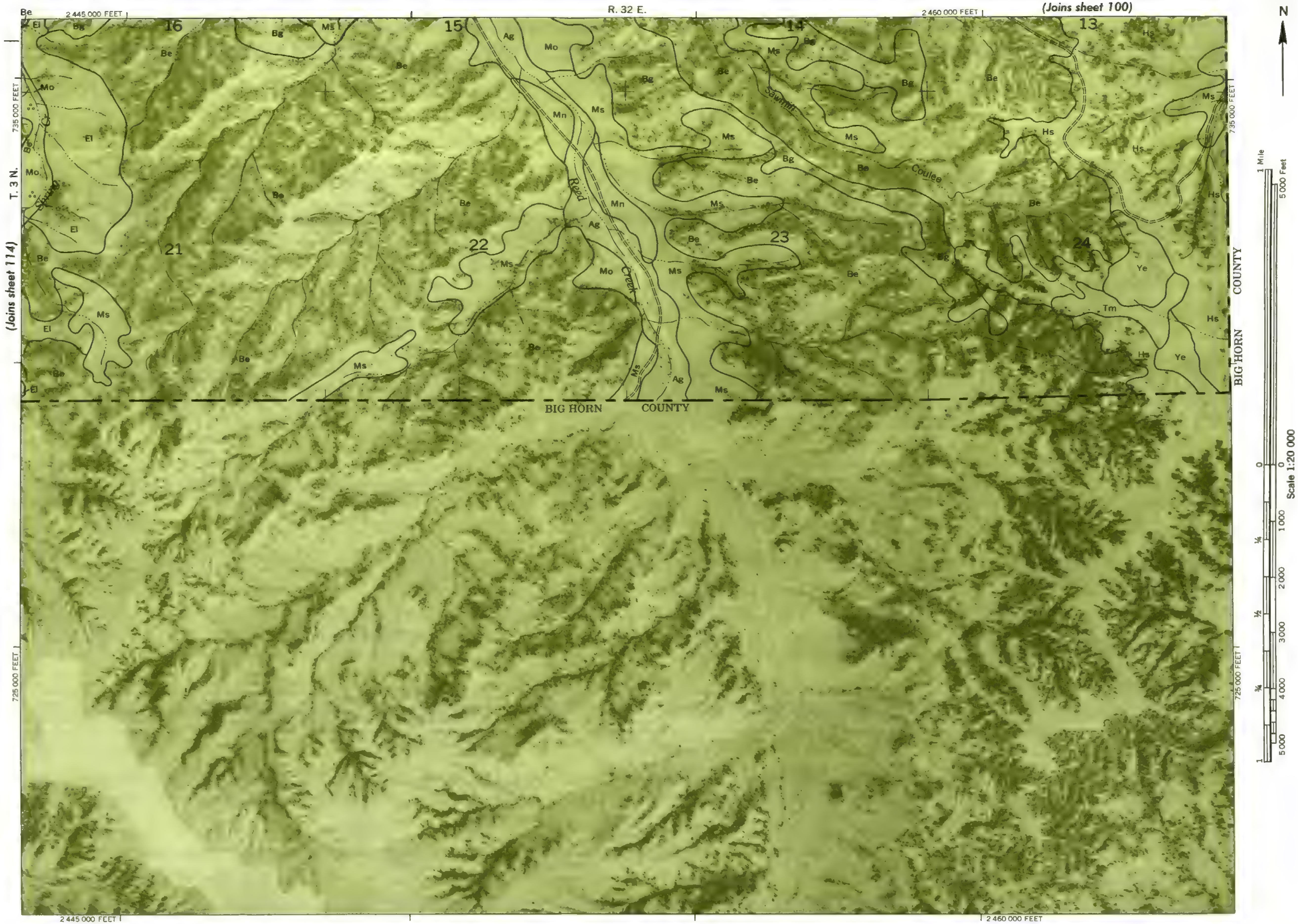


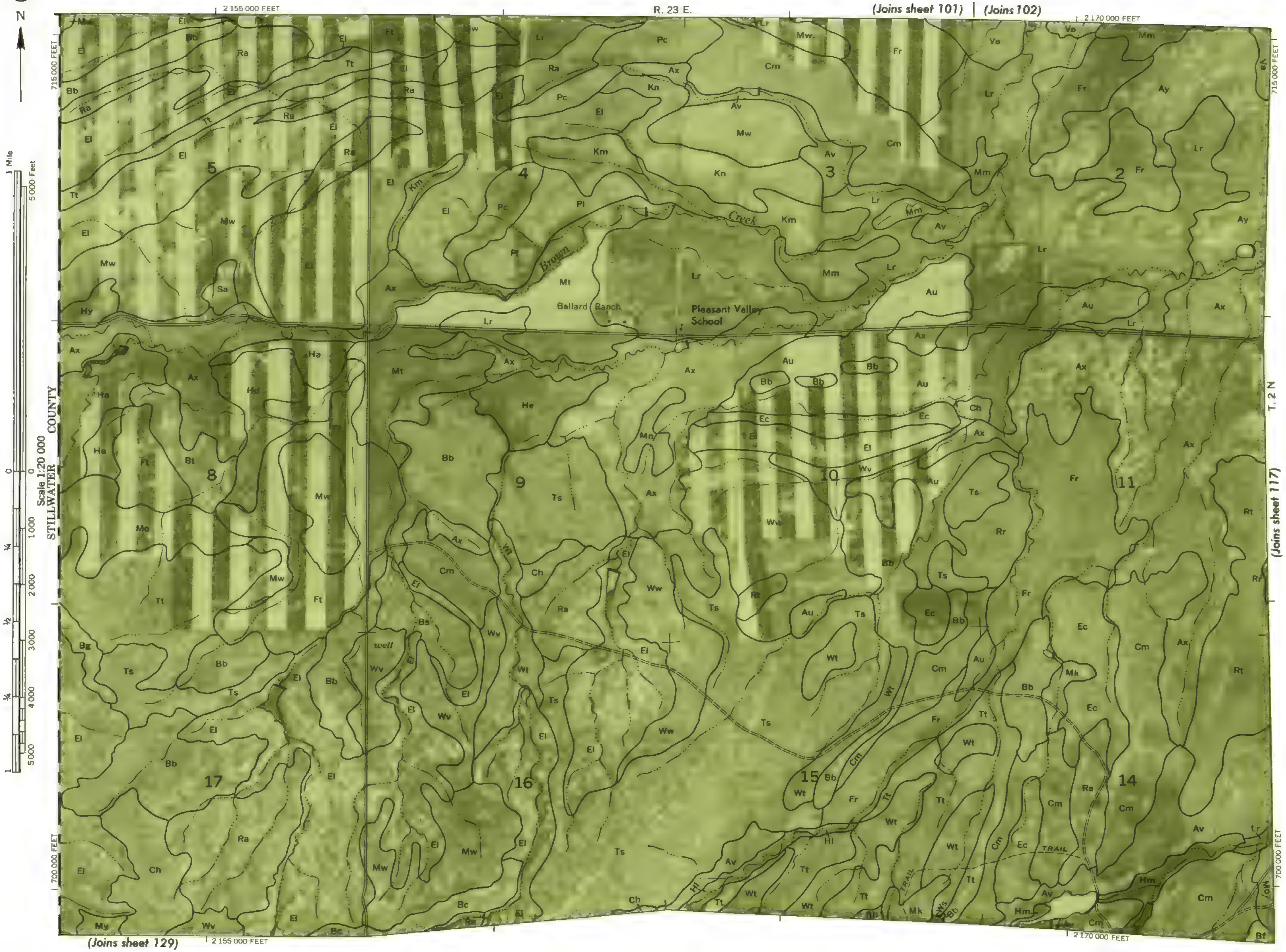
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 115

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 116



YELLOWSTONE COUNTY, MONTANA NO. 116

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

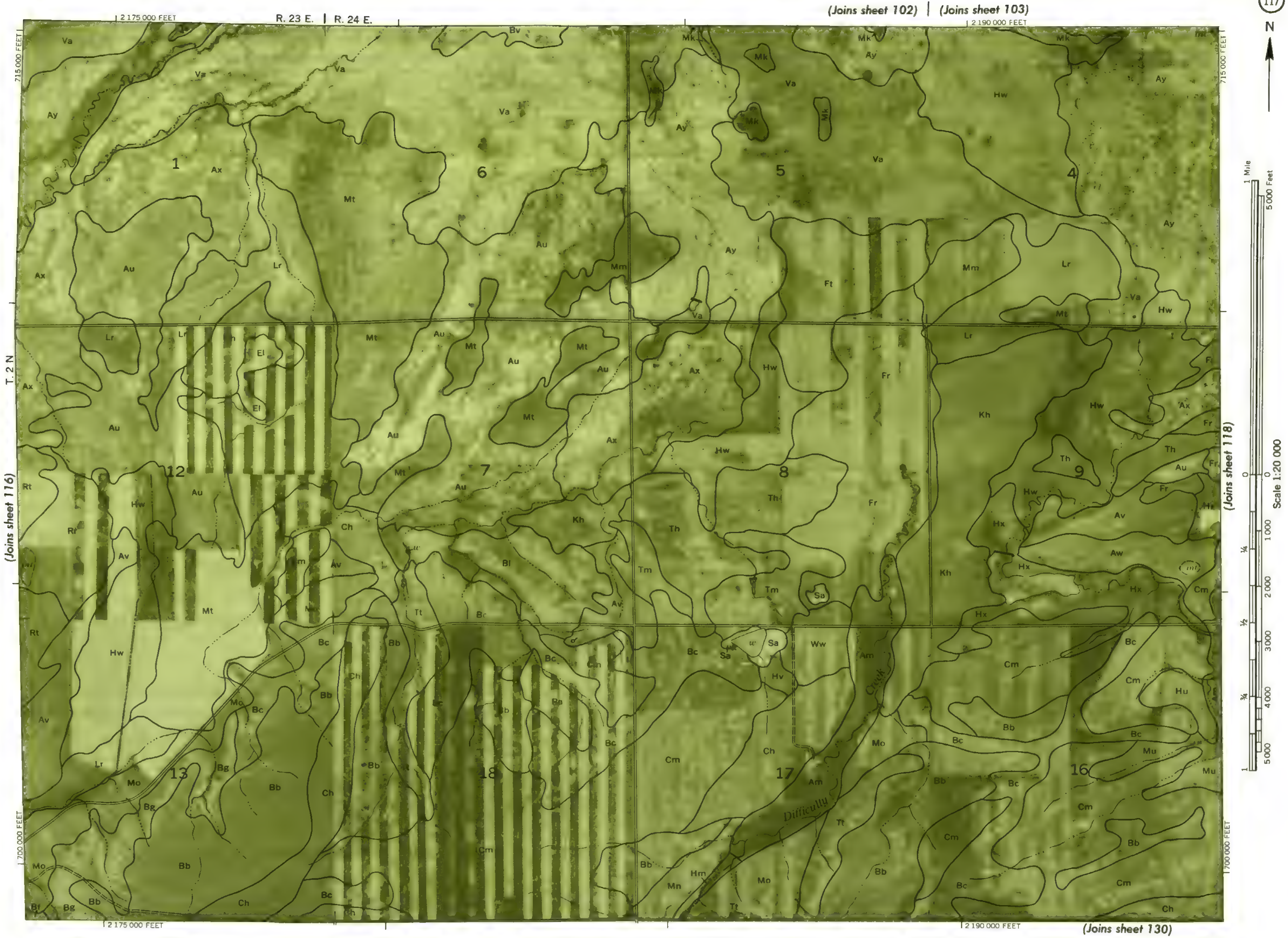


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 117

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 118

N

Scale 1:20 000

1 Mile

0 ¼ ½ ¾ 1

5000 Feet

0 1000 2000 3000 4000 5000

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 118

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 119

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 119

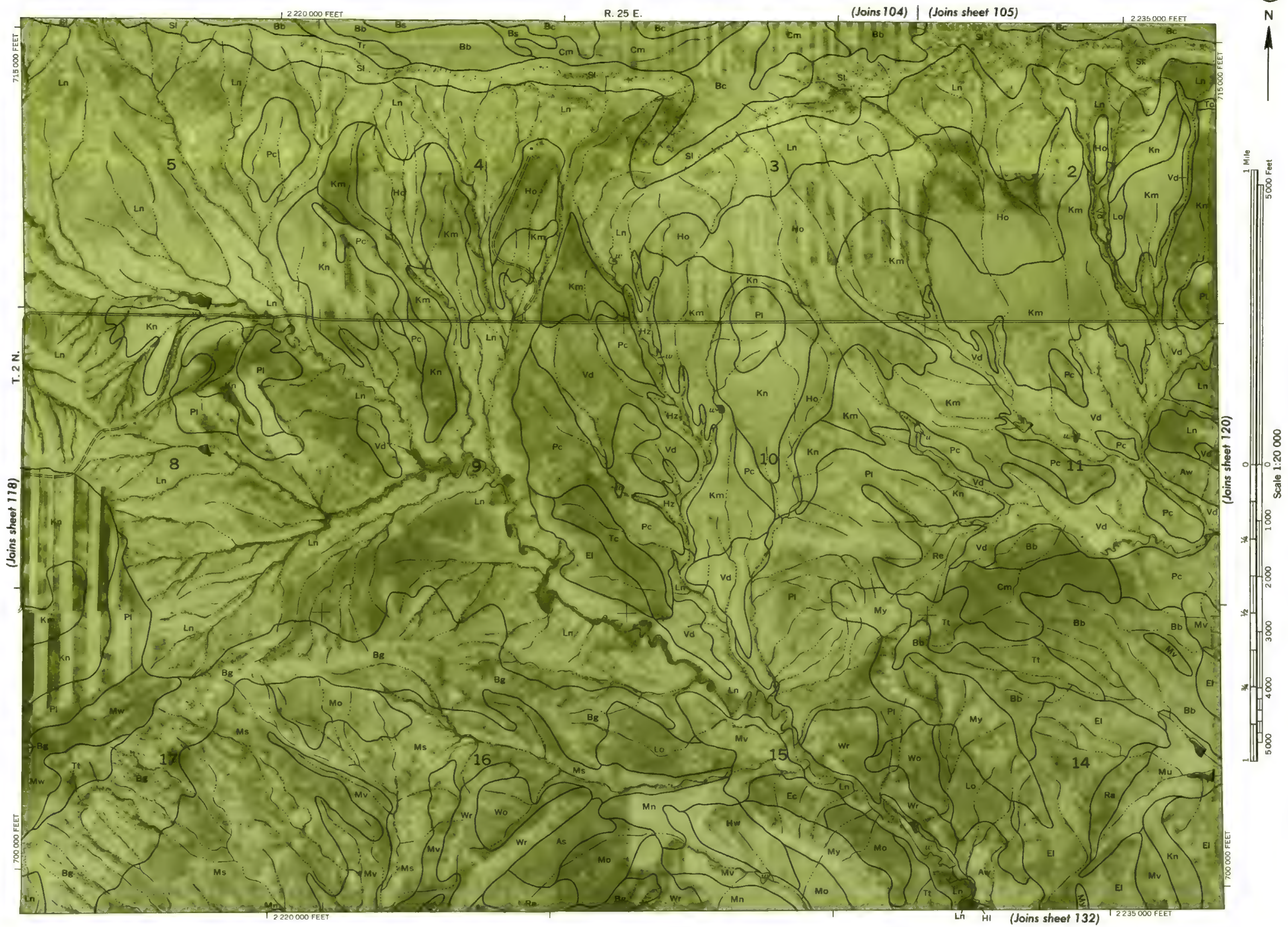


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 12

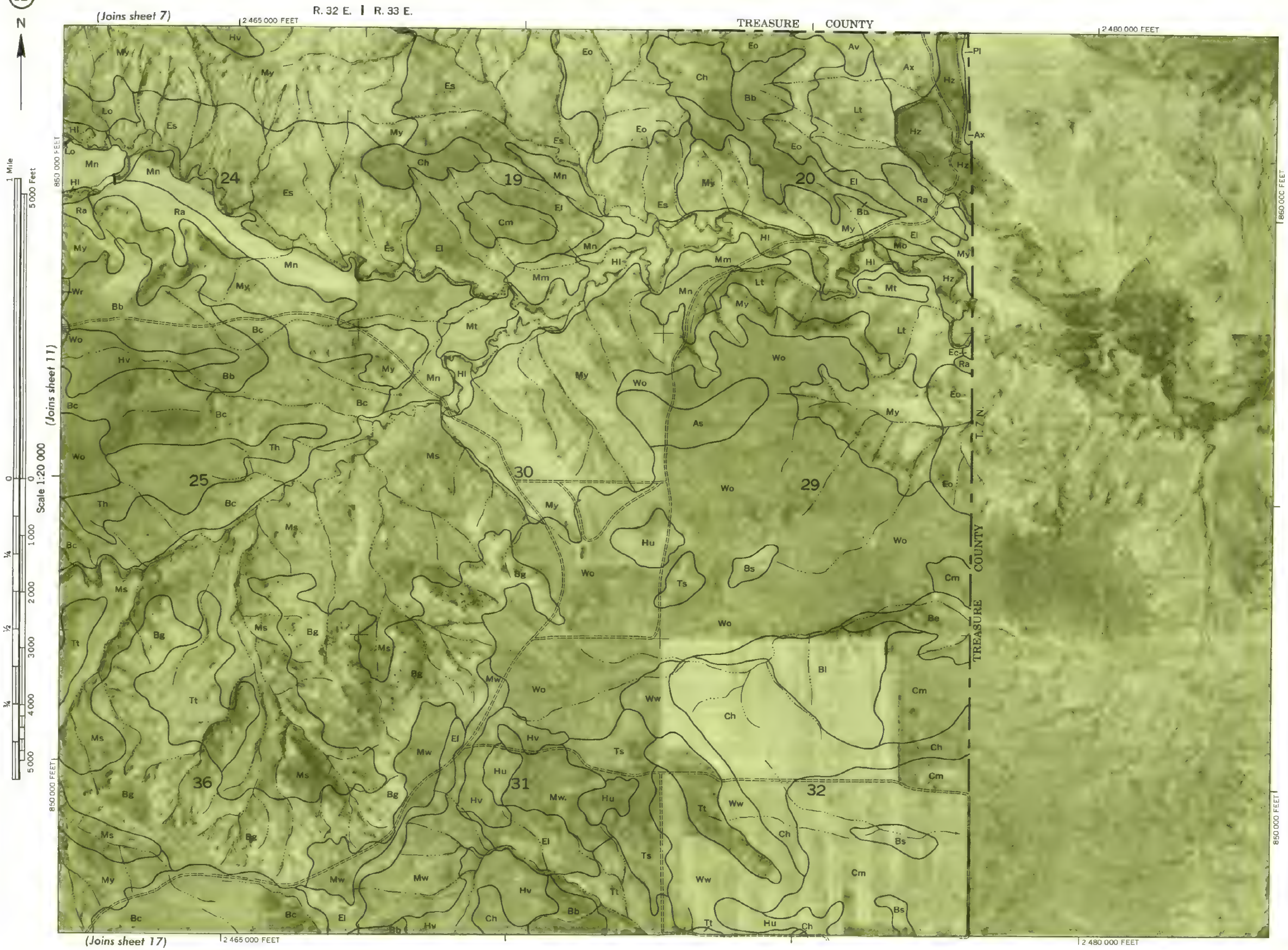


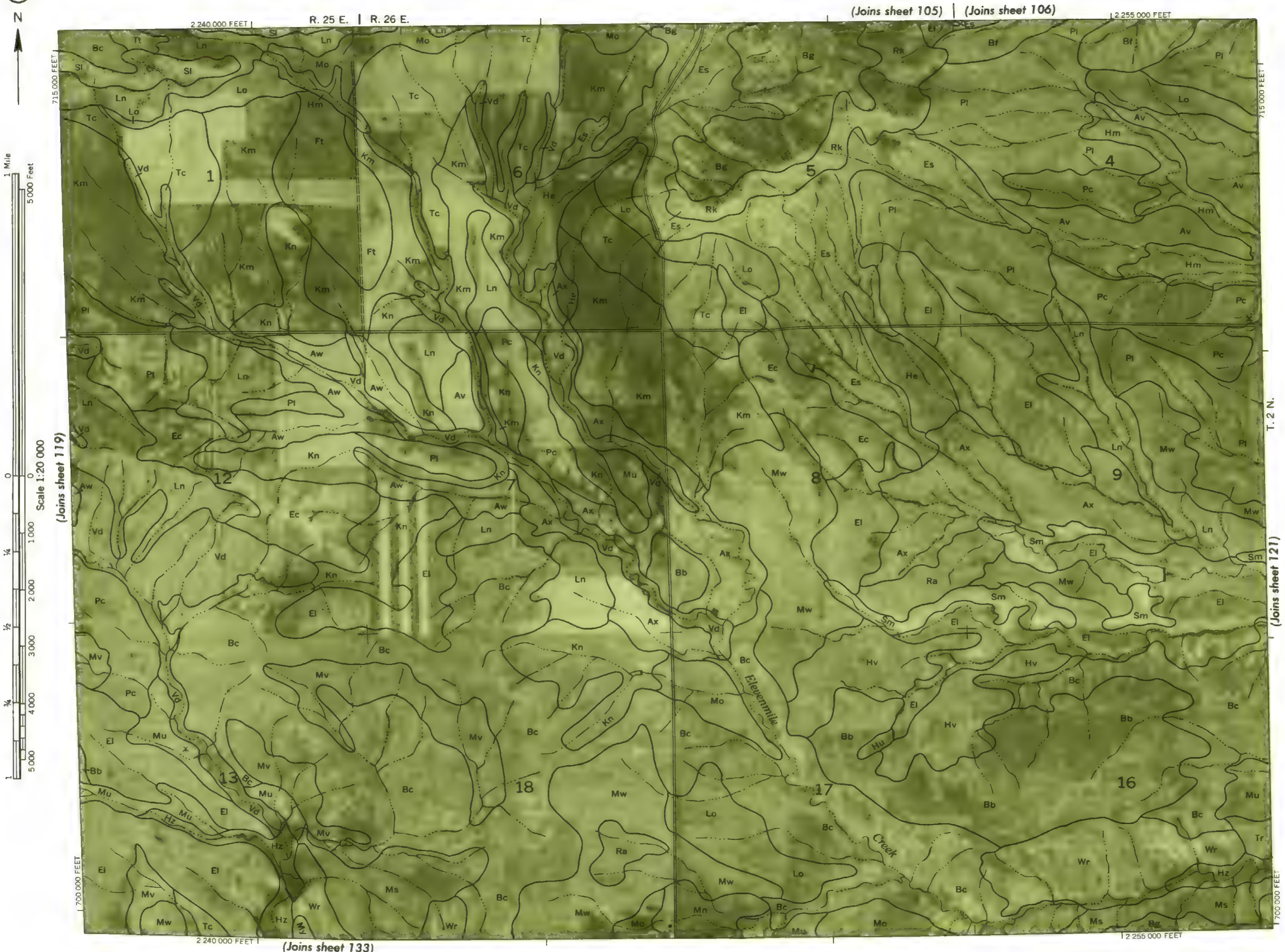
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 12

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 120



YELLOWSTONE COUNTY, MONTANA NO. 120

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

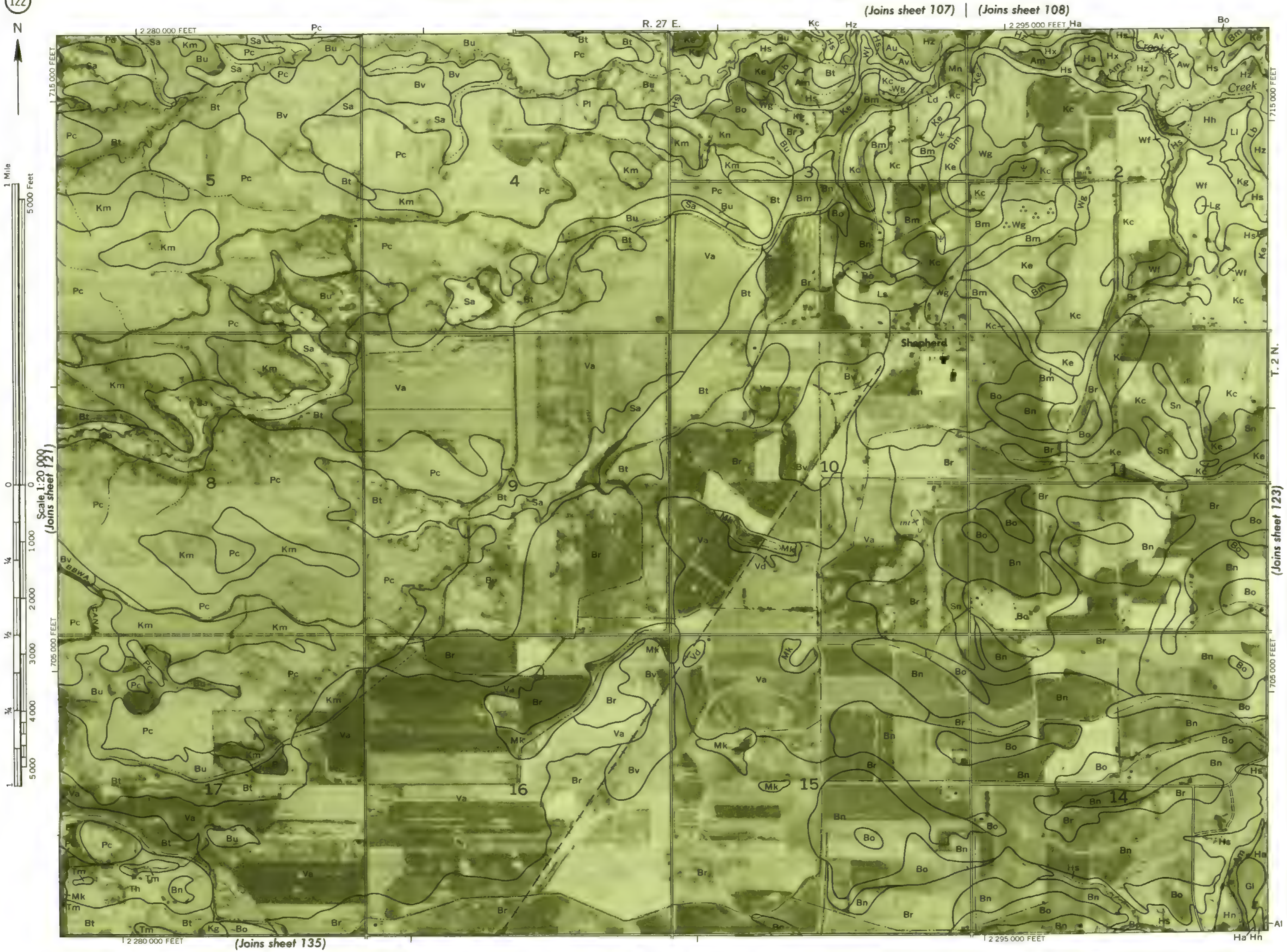
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 121

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 122



YELLOWSTONE COUNTY, MONTANA NO. 122

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 123

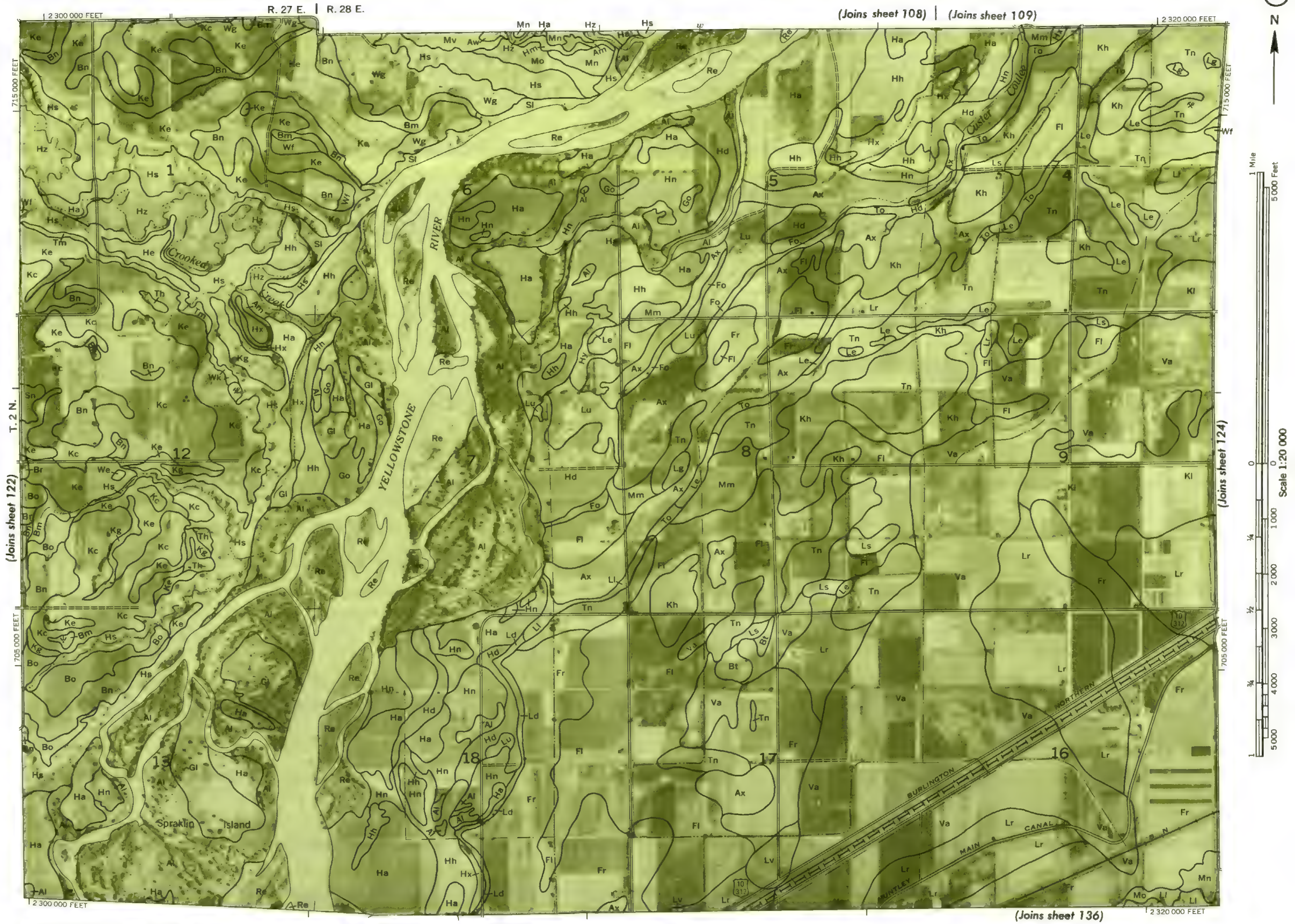


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

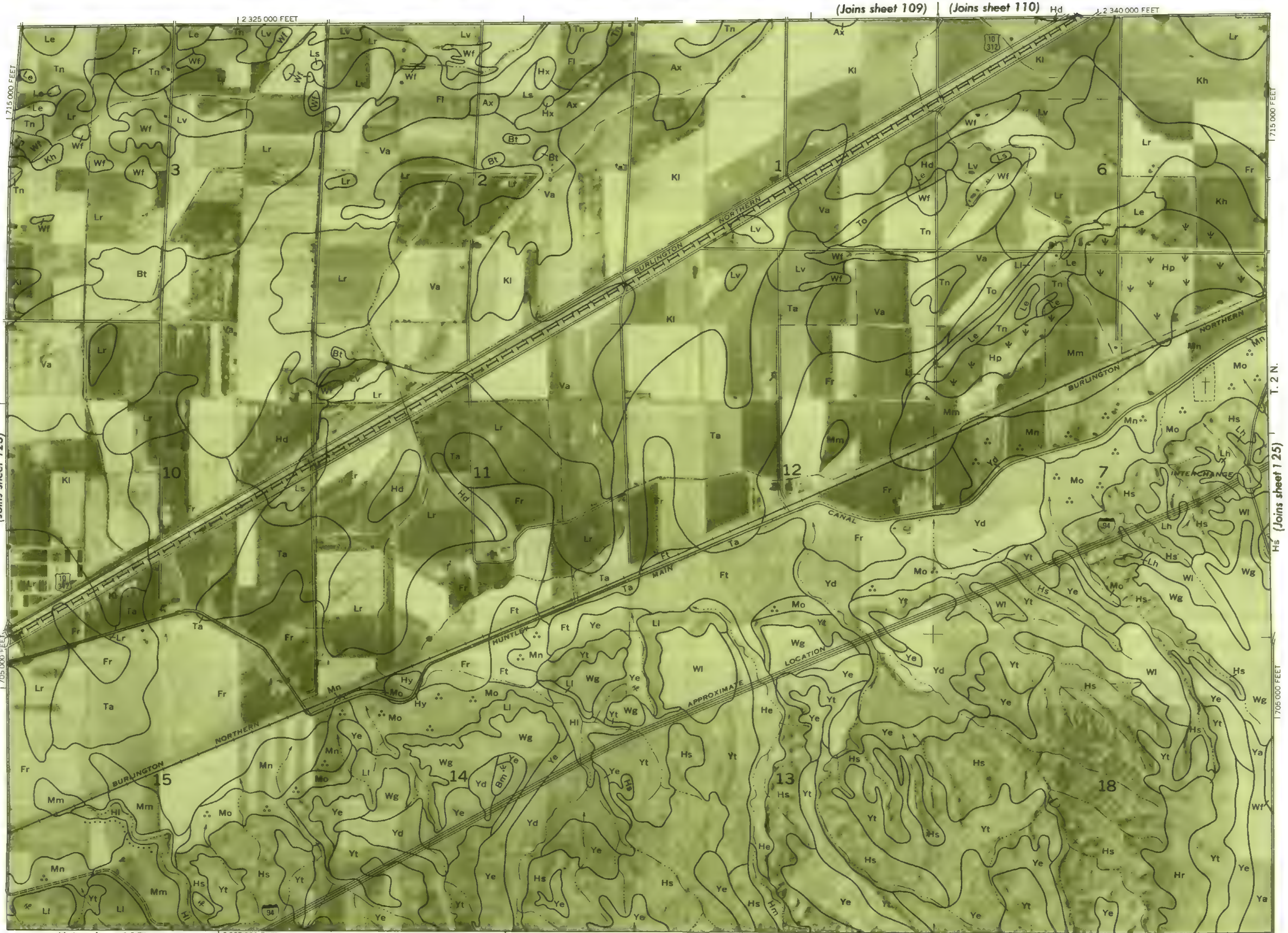
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 123

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 124

R. 28 E. | R. 29 E.
(Joins sheet 109) | *(Joins sheet 110)*

N



(Joins sheet 123)

(Joins sheet 125)

(Joins sheet 137)

Scale 1:20 000

1 Mile
0 ¼ ½ ¾ 1
5 000 Feet
0 1 000 2 000 3 000 4 000 5 000

YELLOWSTONE COUNTY, MONTANA NO. 124

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

125

N

1 Mile

5000 Feet

Scale 1:20 000

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

126

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 126

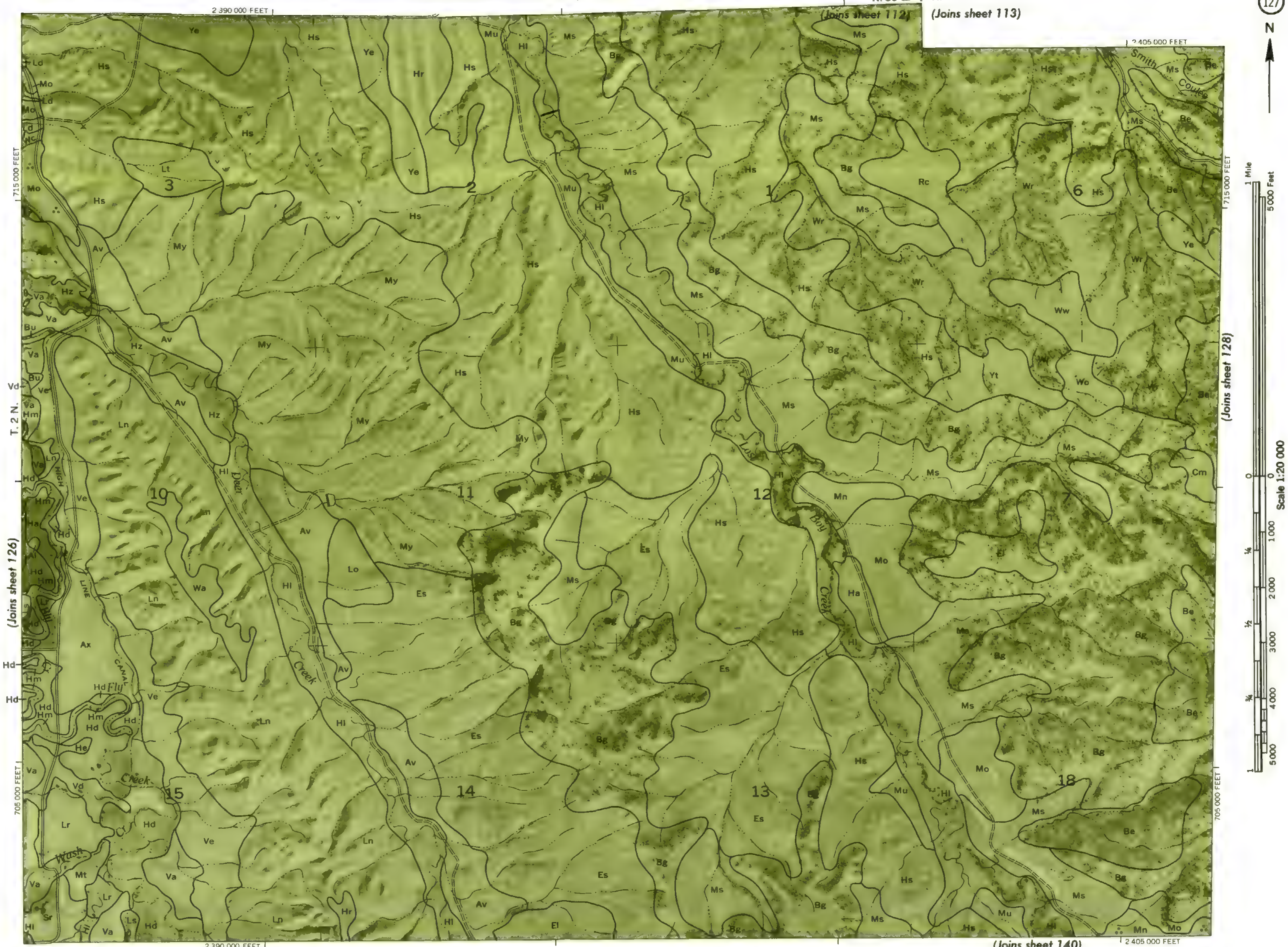
R. 29 E. | R. 30 E. (Joins sheet 111) | (Joins sheet 112)

YELLOWSTONE COUNTY, MONTANA NO. 126

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

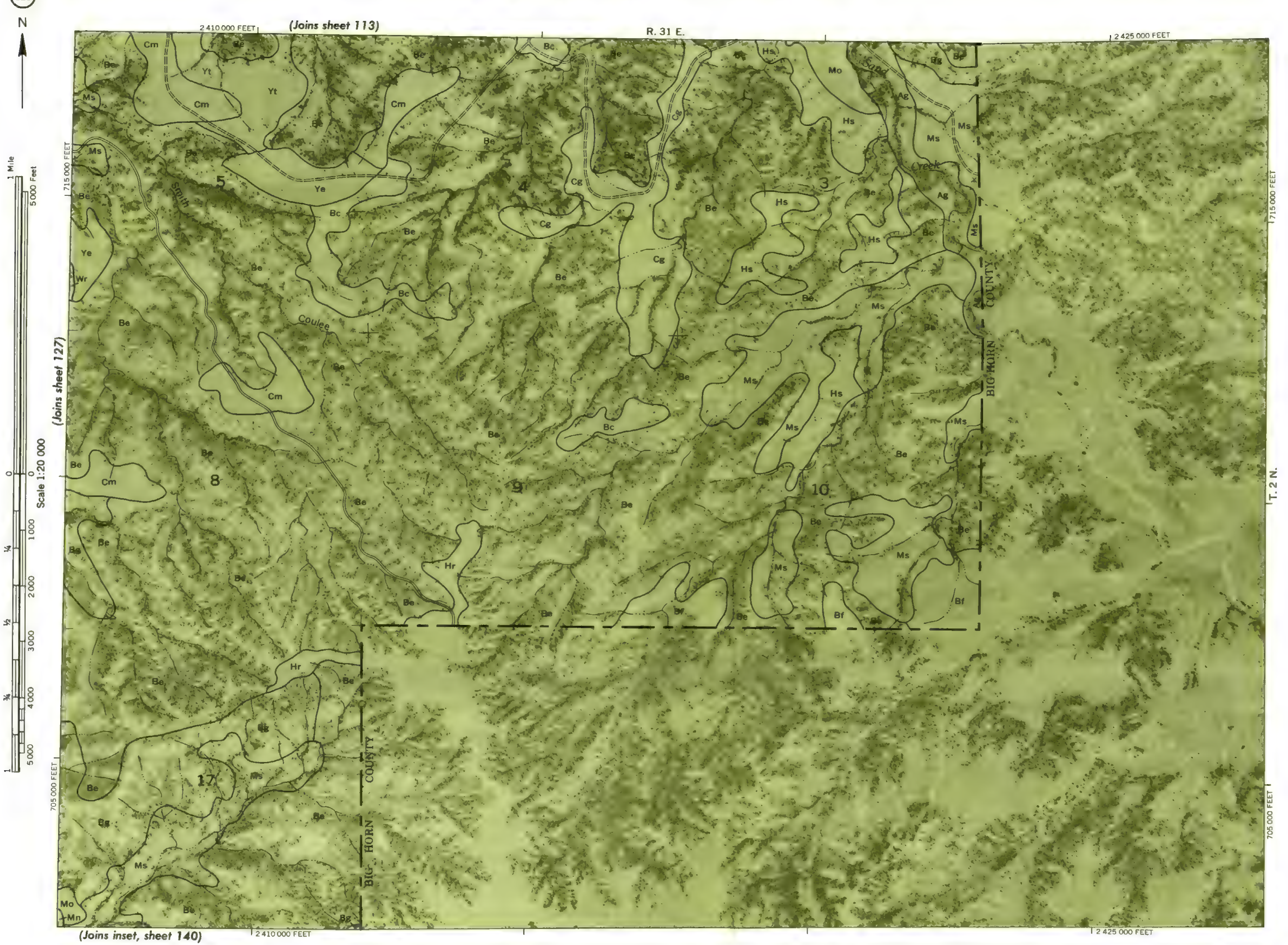


This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 127

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 128



YELLOWSTONE COUNTY, MONTANA NO. 128

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

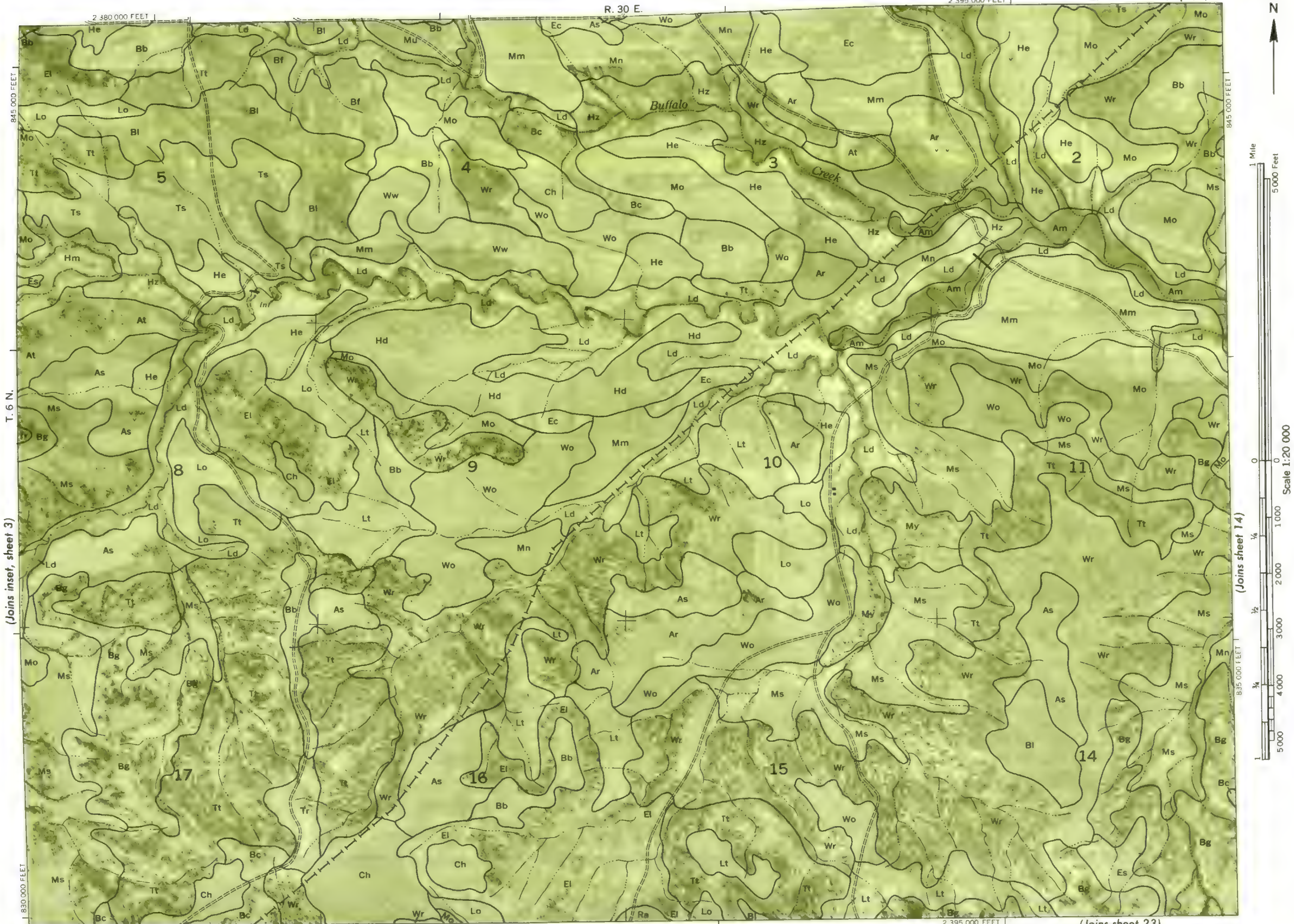
YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 129

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 129

(Joins sheet 8) | (9)



(Joins inset, sheet 3)

(Joins sheet 14)

(Joins sheet 23)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 130

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 130

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 131

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

132

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 132

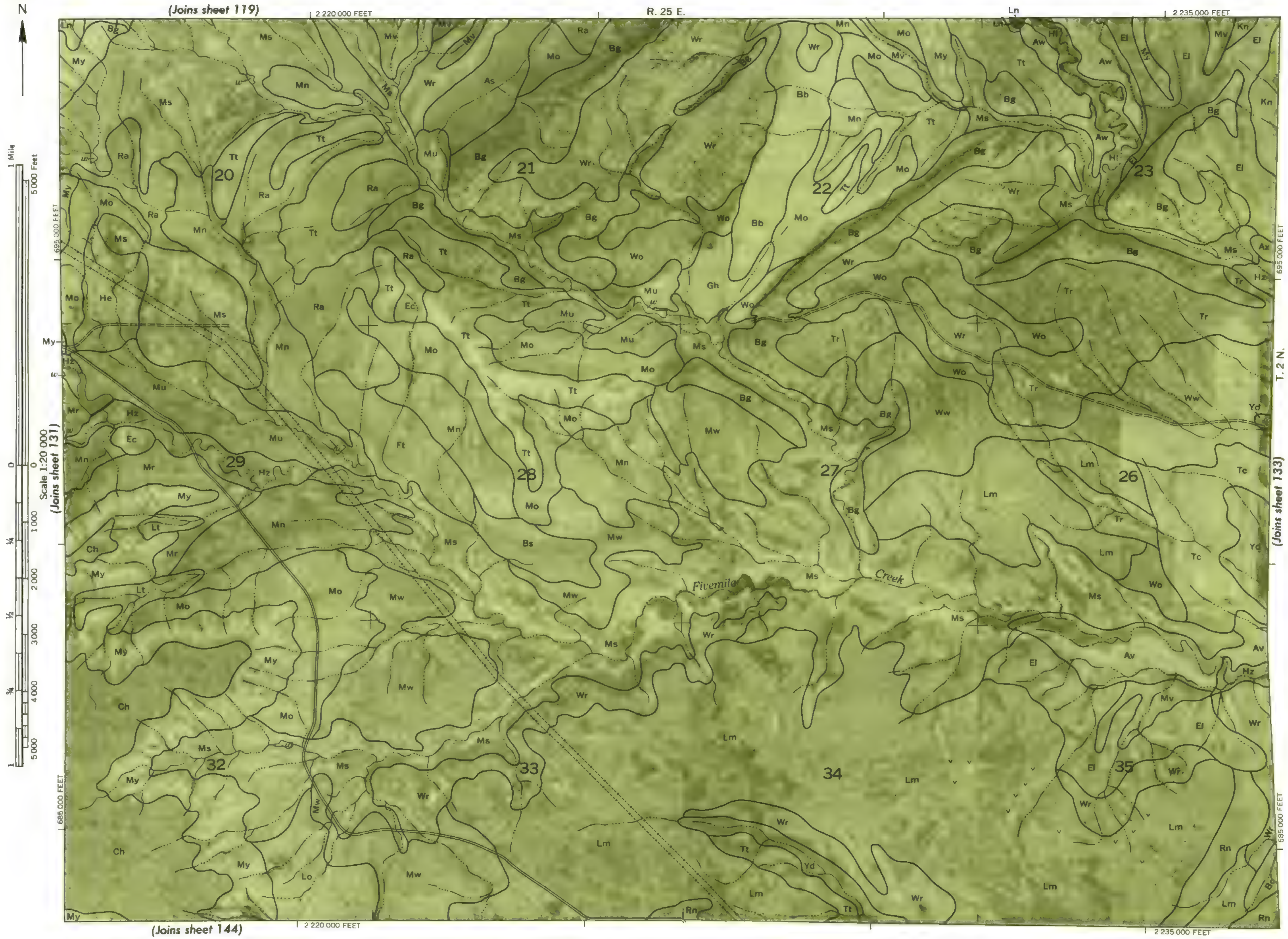


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 132

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

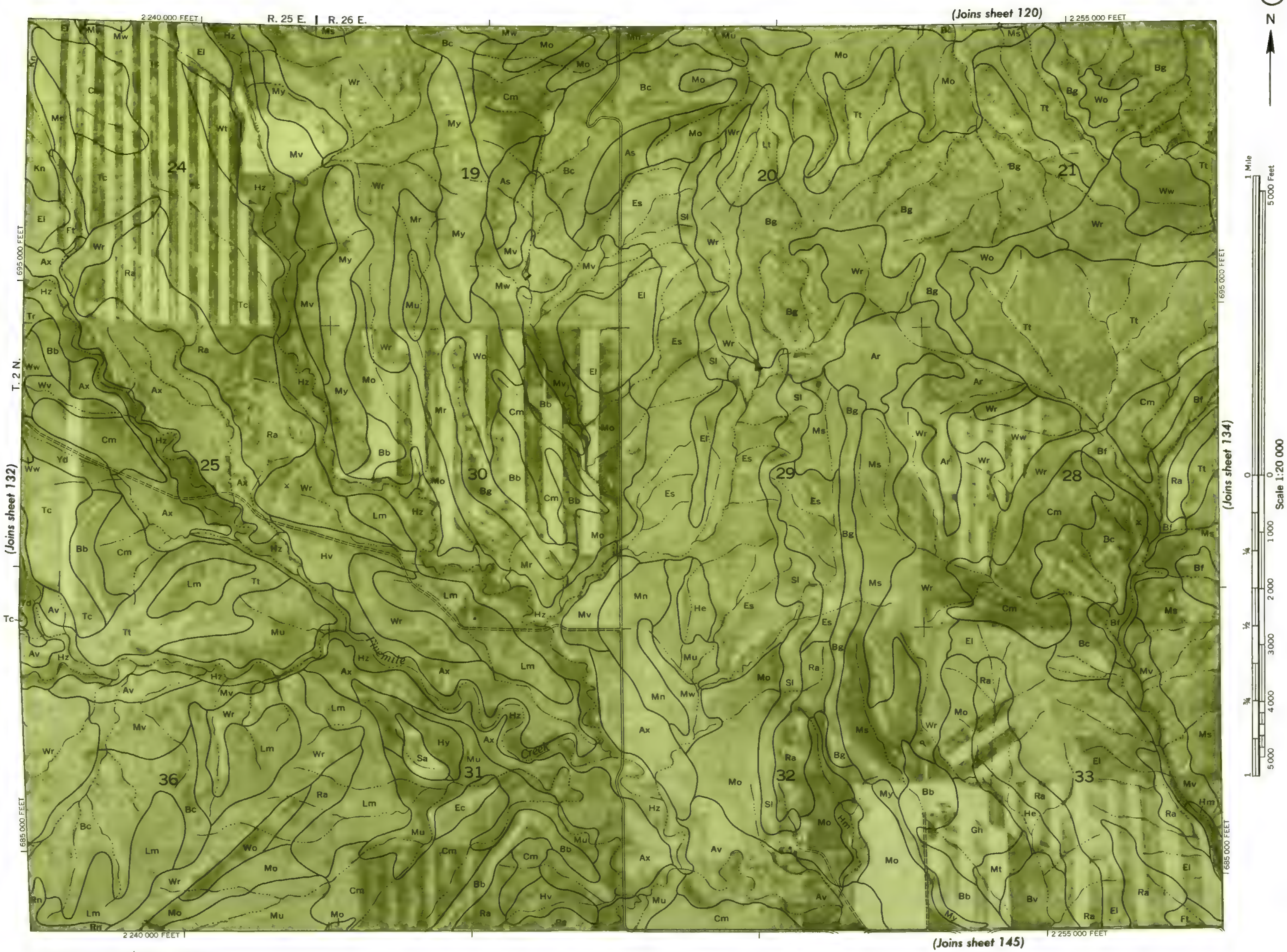


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 134

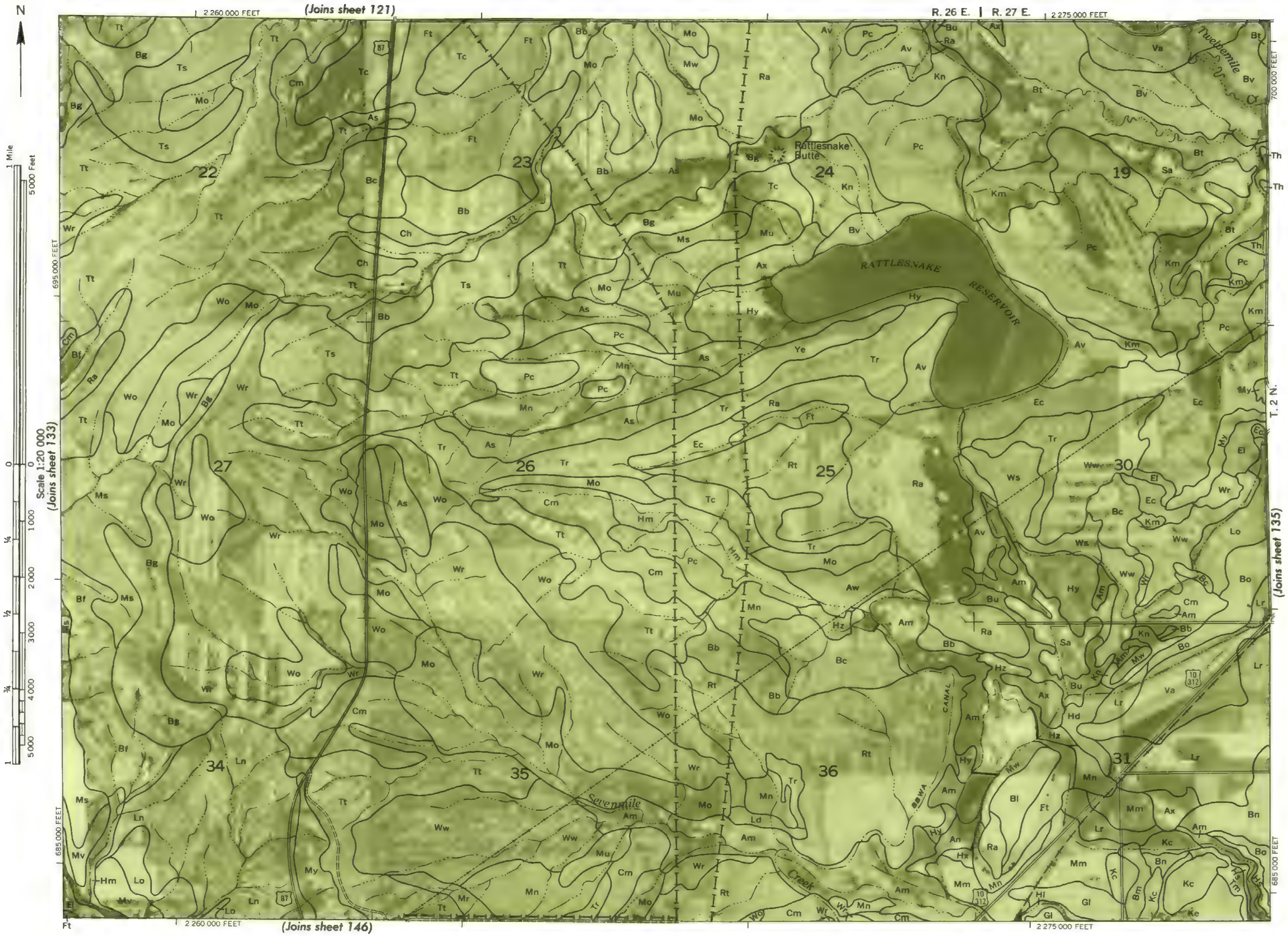


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 134

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

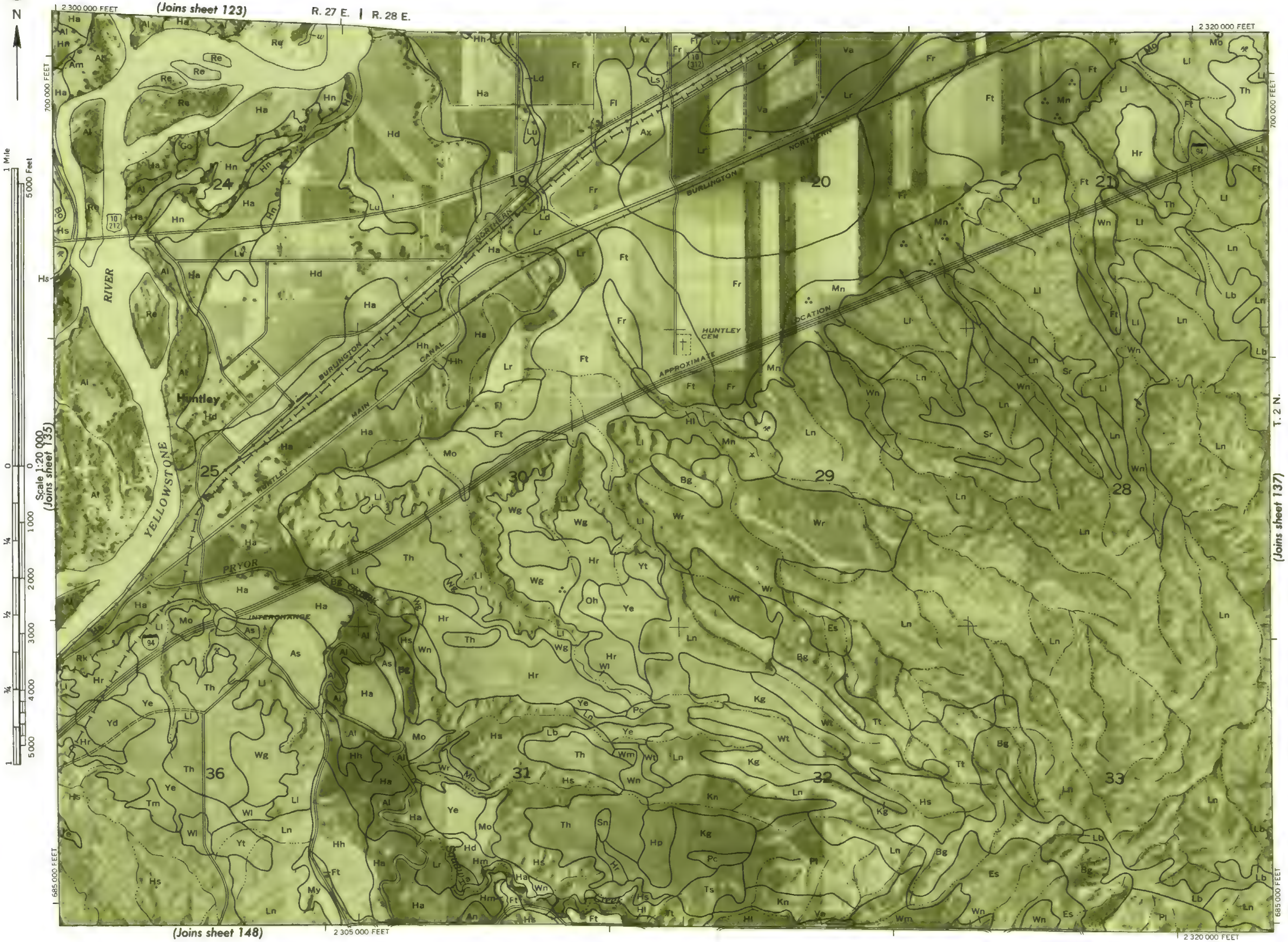
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 135

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 136



YELLOWSTONE COUNTY, MONTANA NO. 136

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

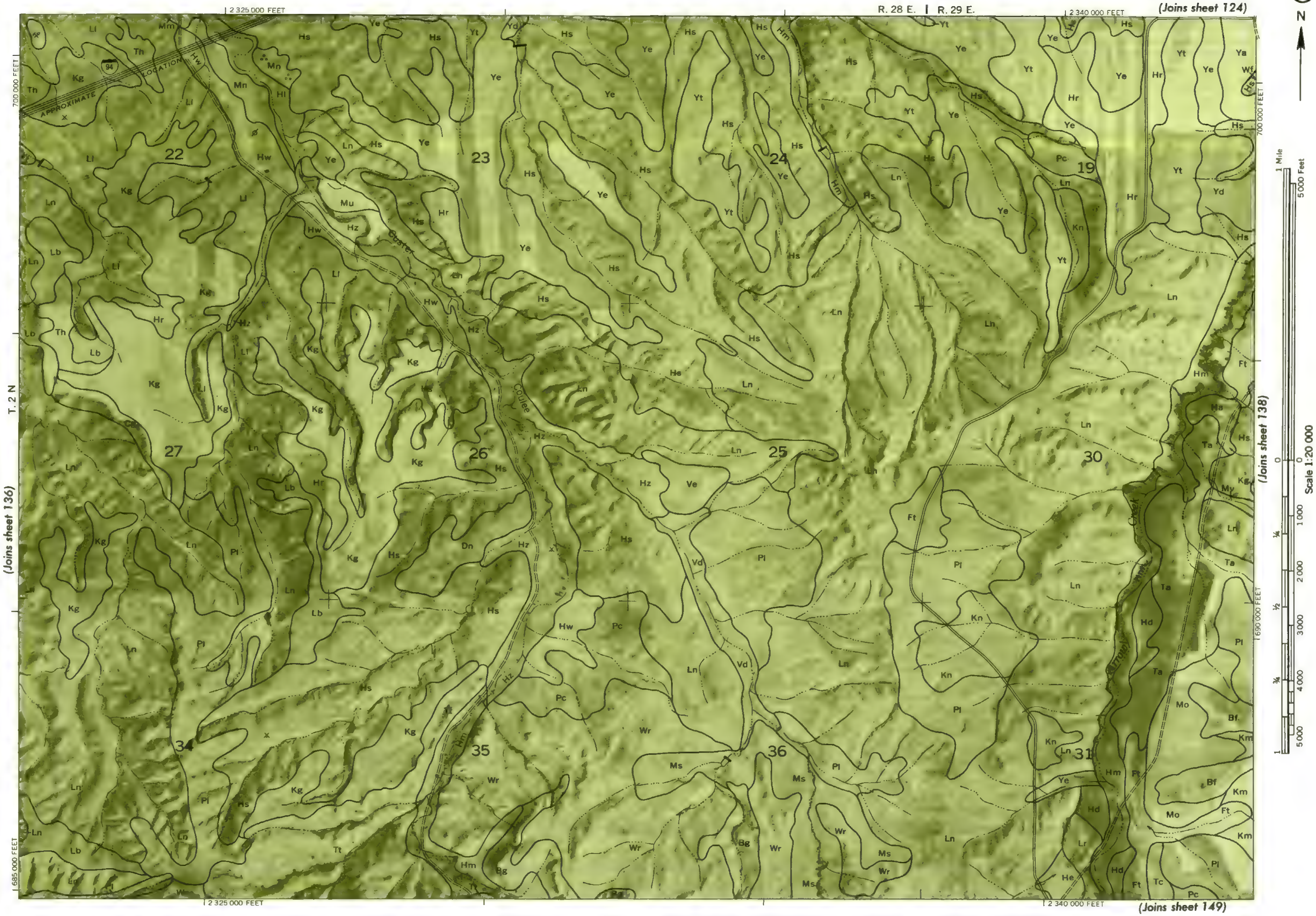
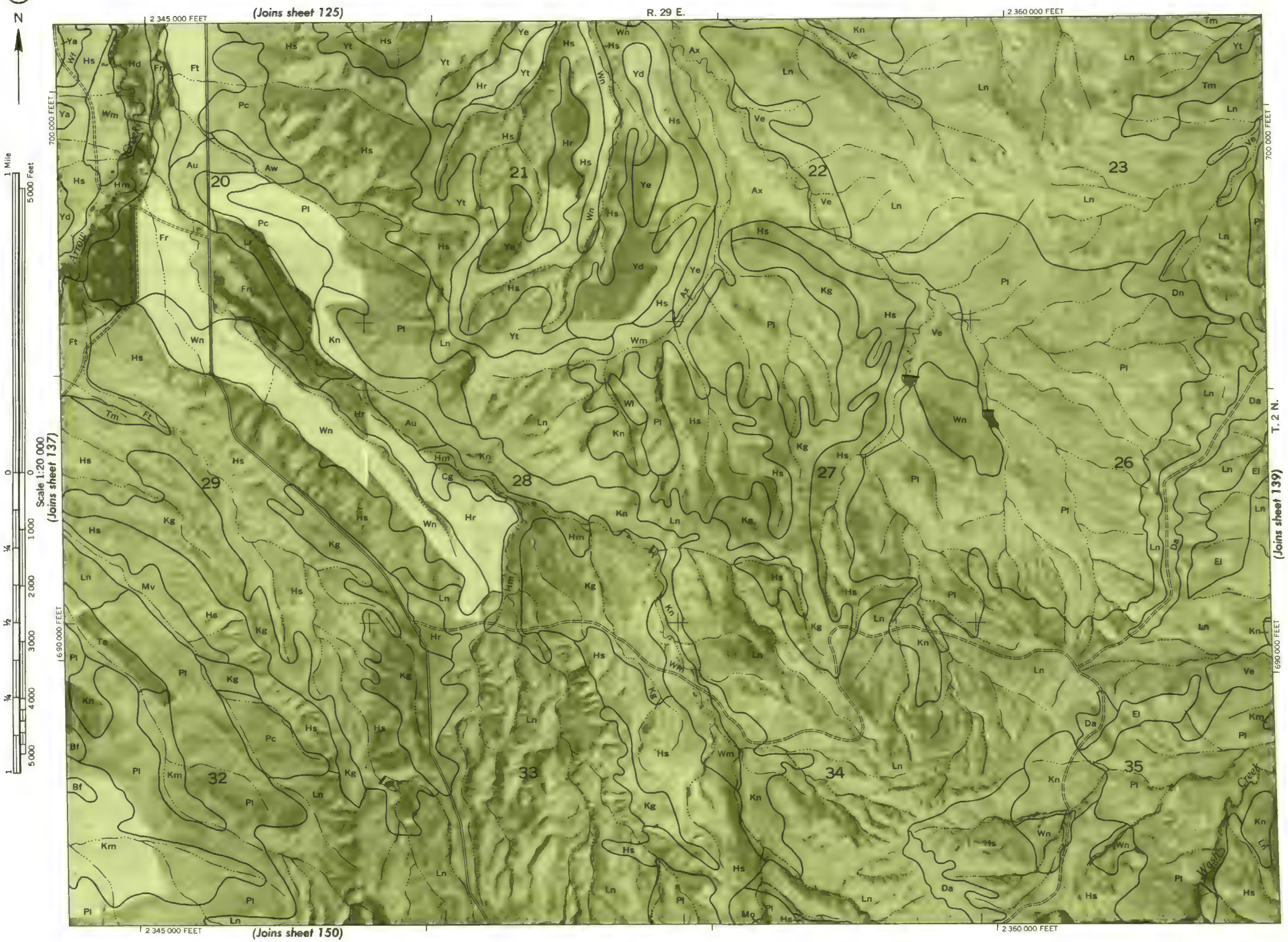


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 137



YELLOWSTONE COUNTY, MONTANA NO. 138

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

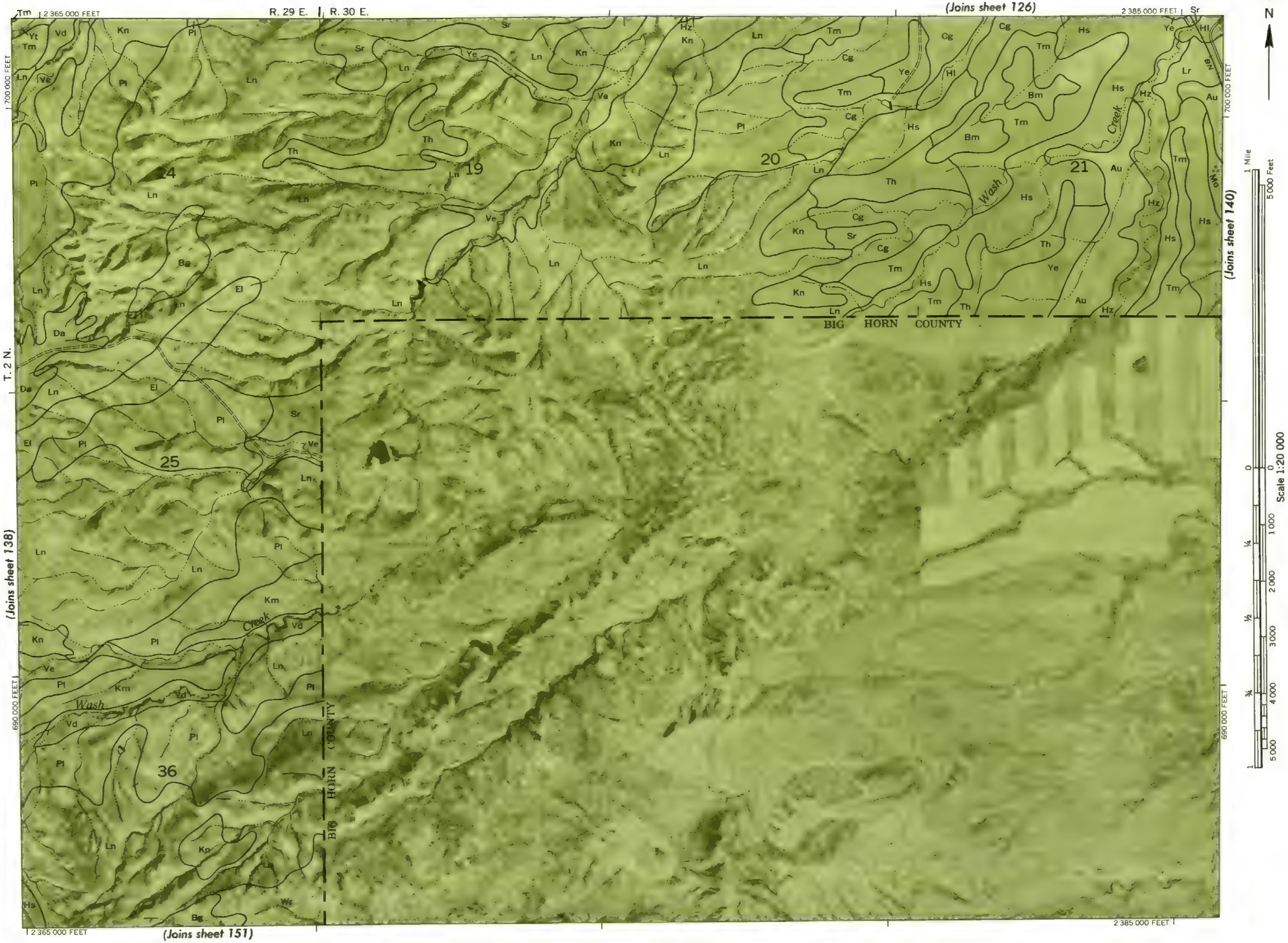


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA NO. 139

14

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 14

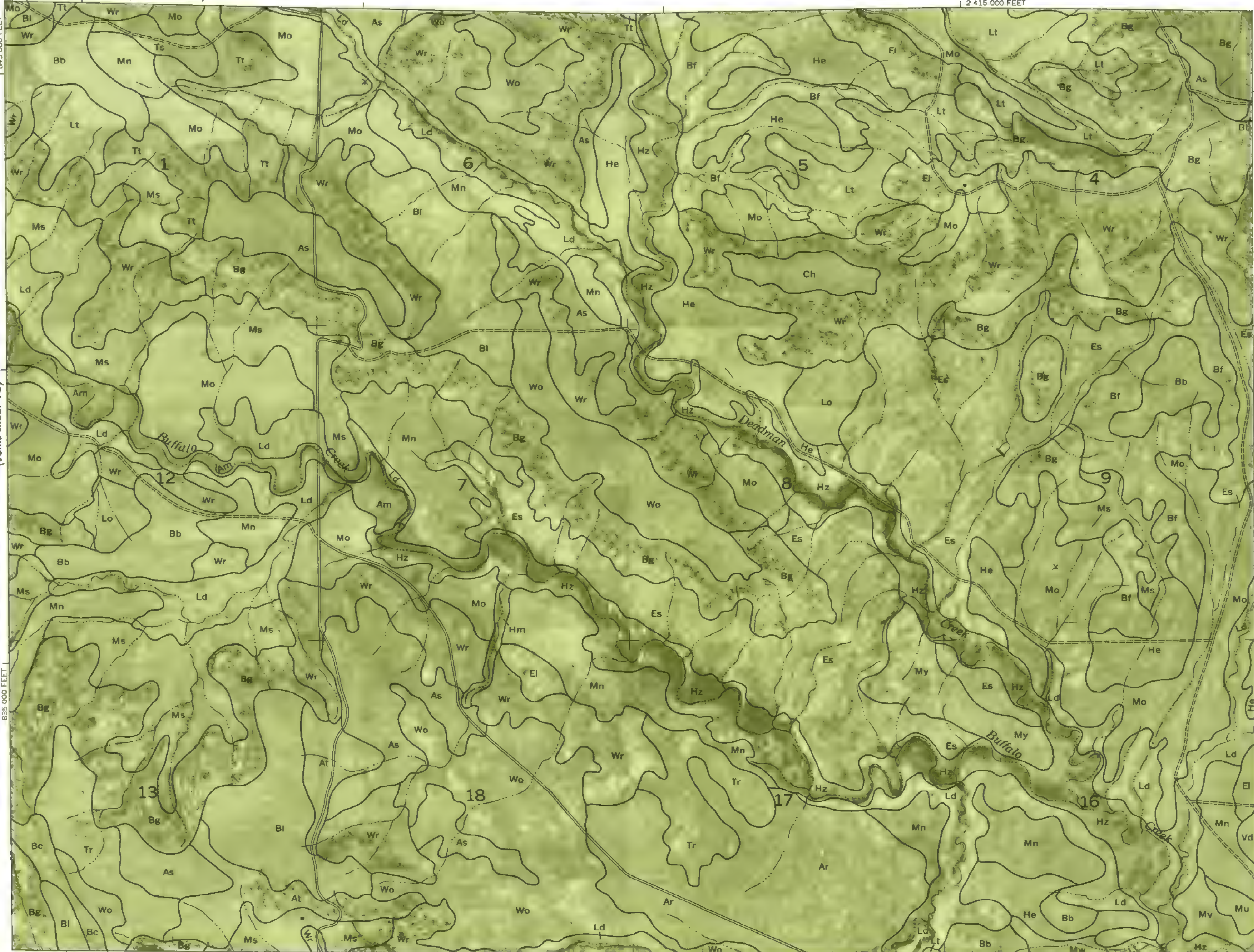


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 14

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 140

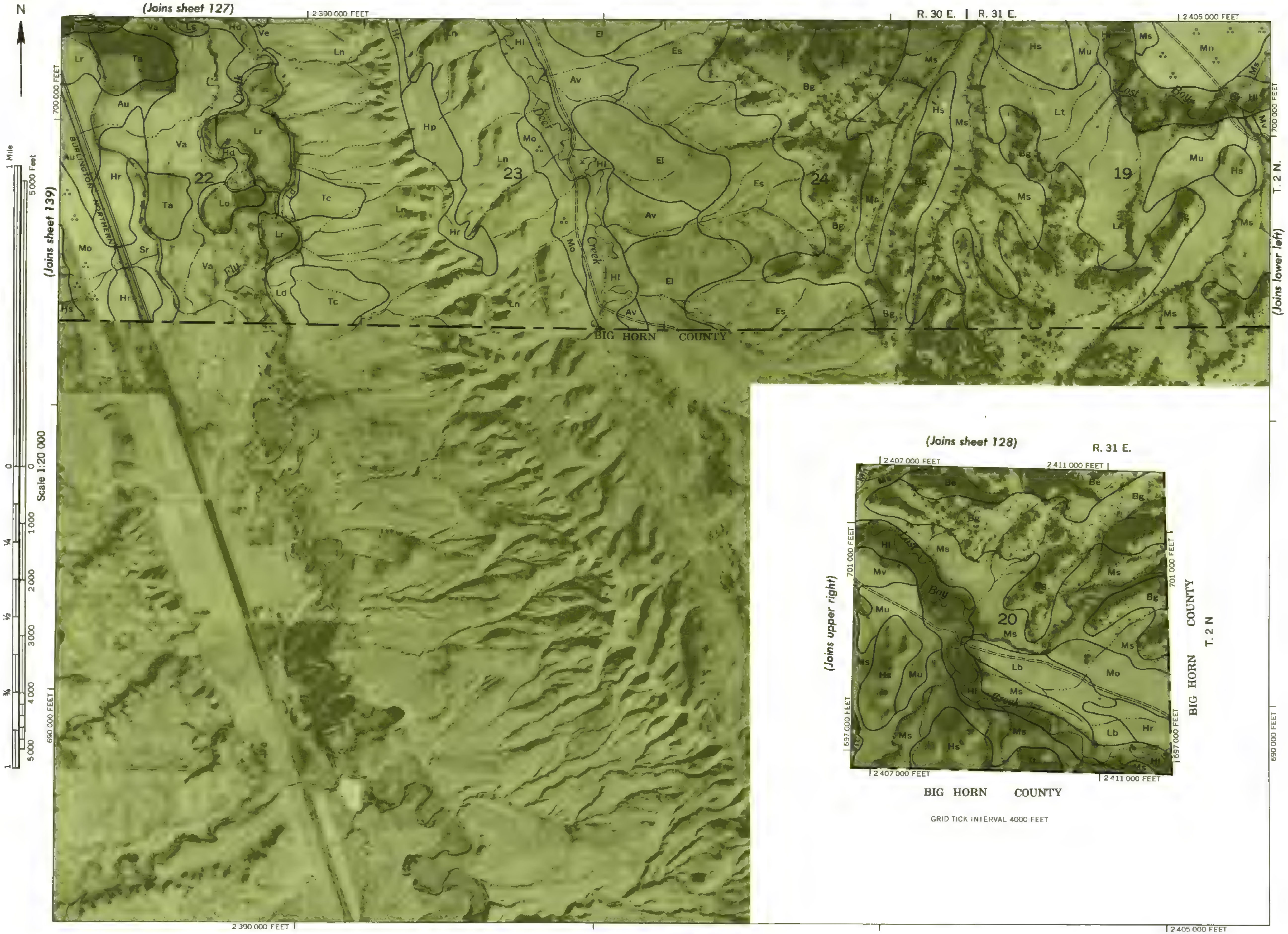


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 140

Land division corners are approximately positioned on this map.

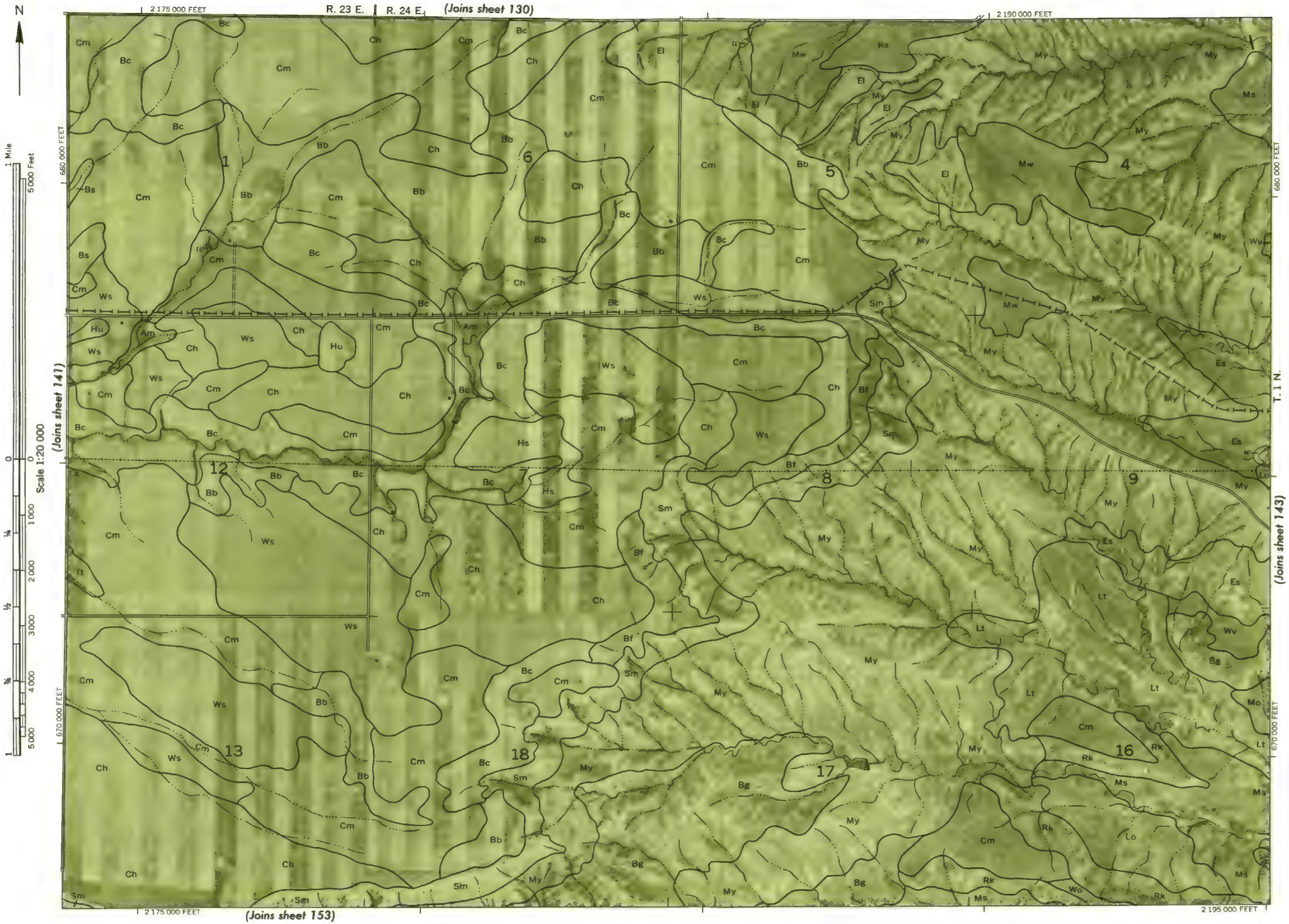
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA NO. 141

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 142

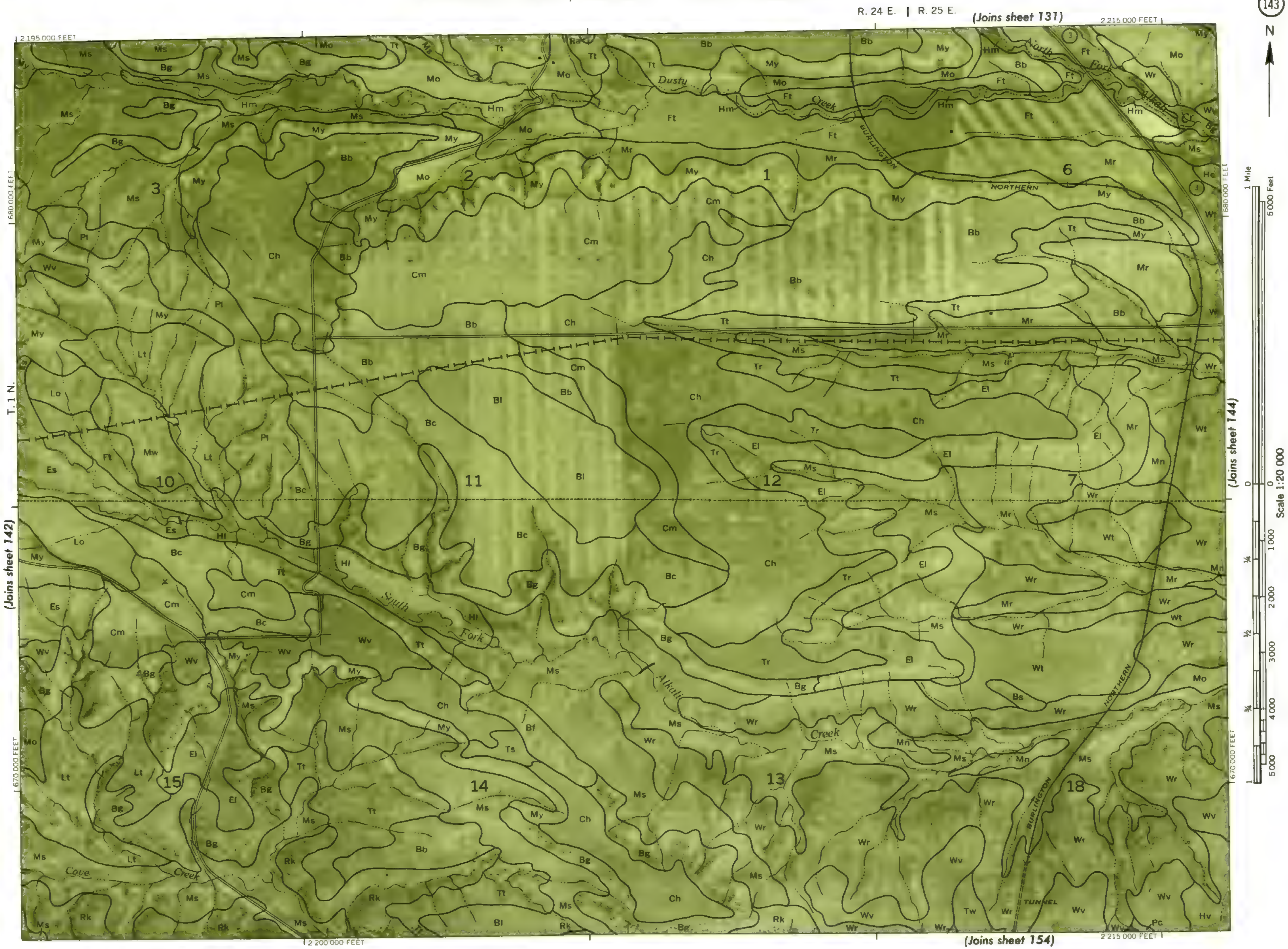


YELLOWSTONE COUNTY, MONTANA NO. 142

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 143

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

144

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 144

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 144

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 145

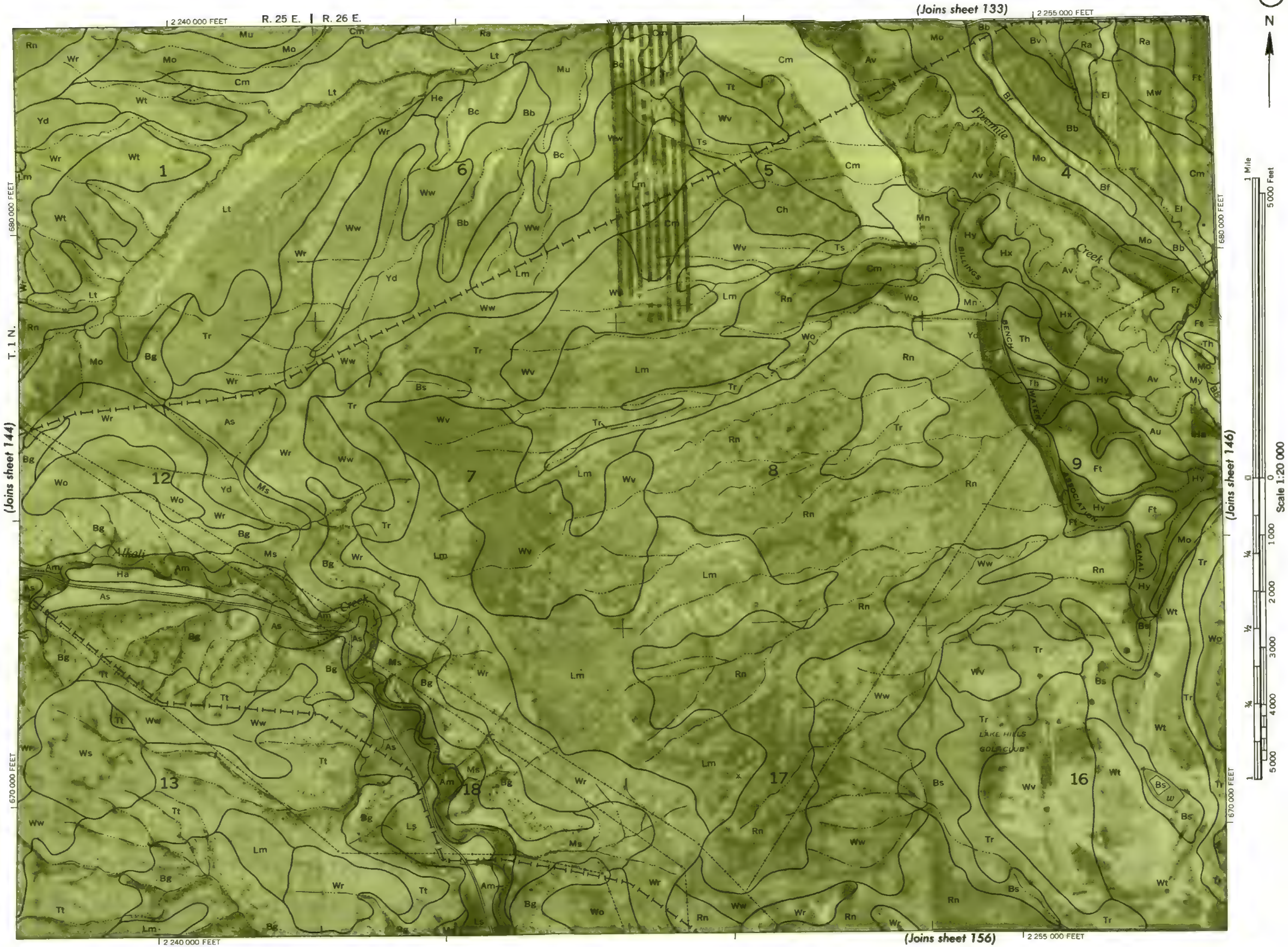


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 146

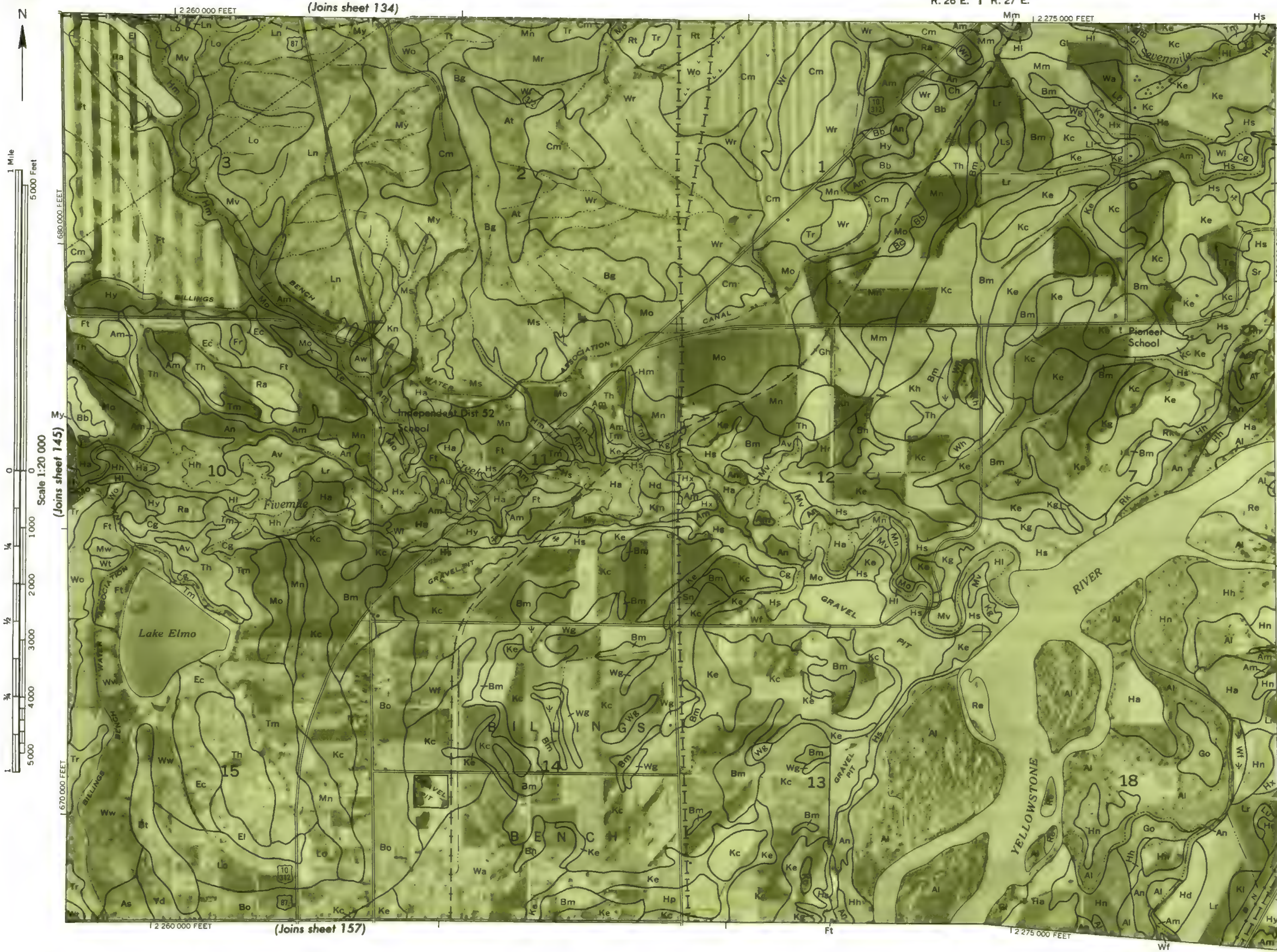
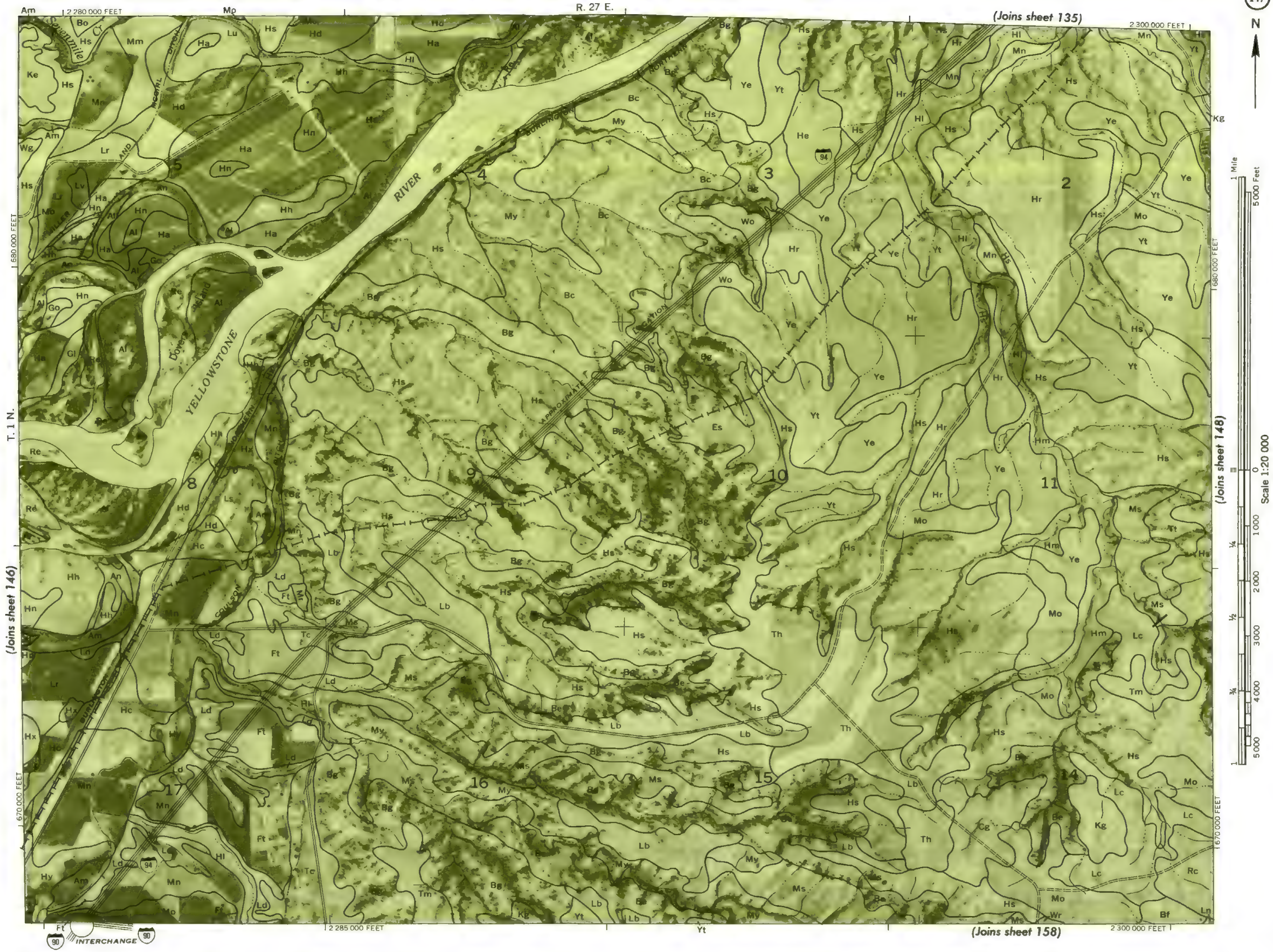


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 146

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station



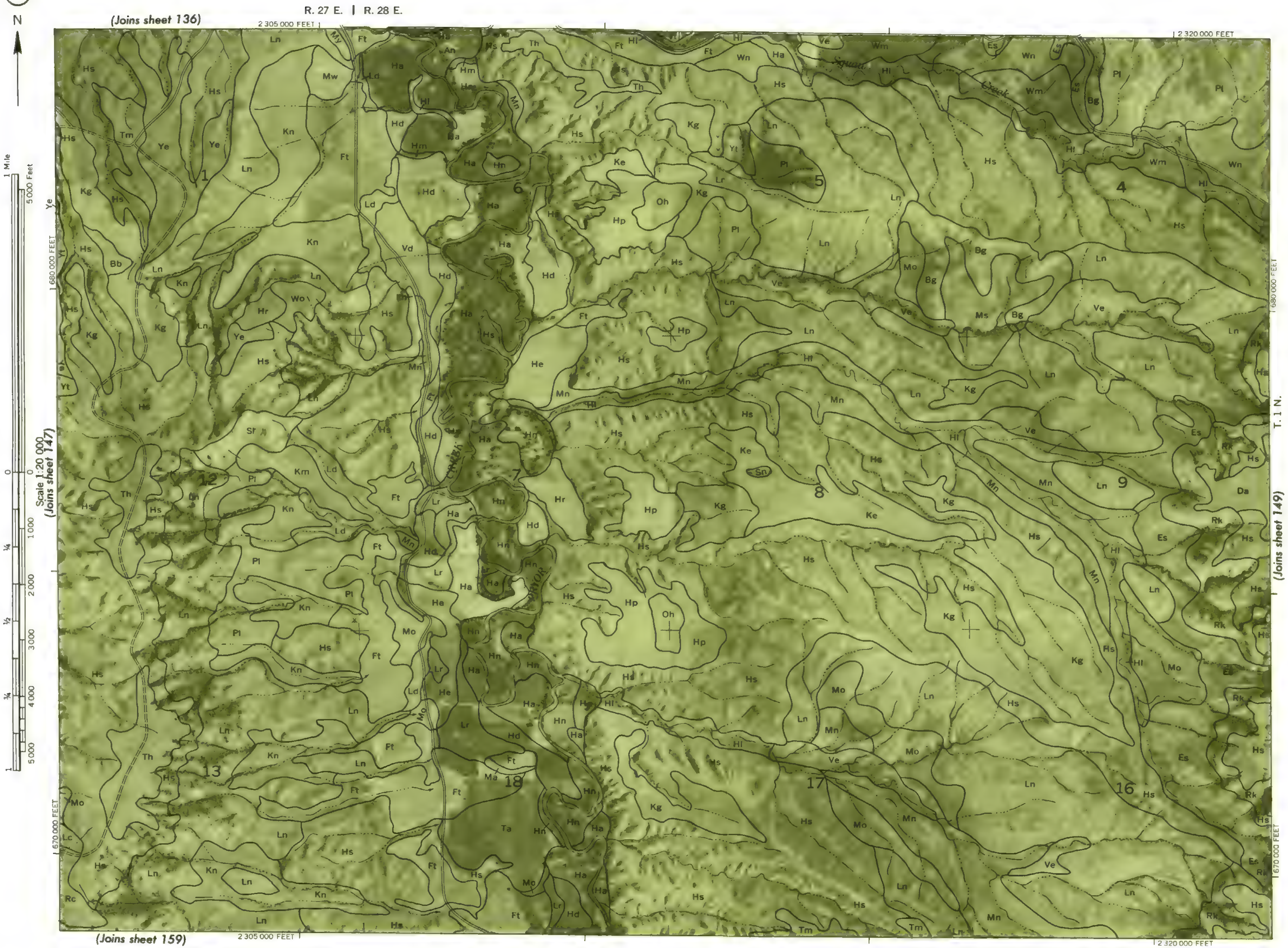
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 147

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 148



YELLOWSTONE COUNTY, MONTANA NO. 148

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 149

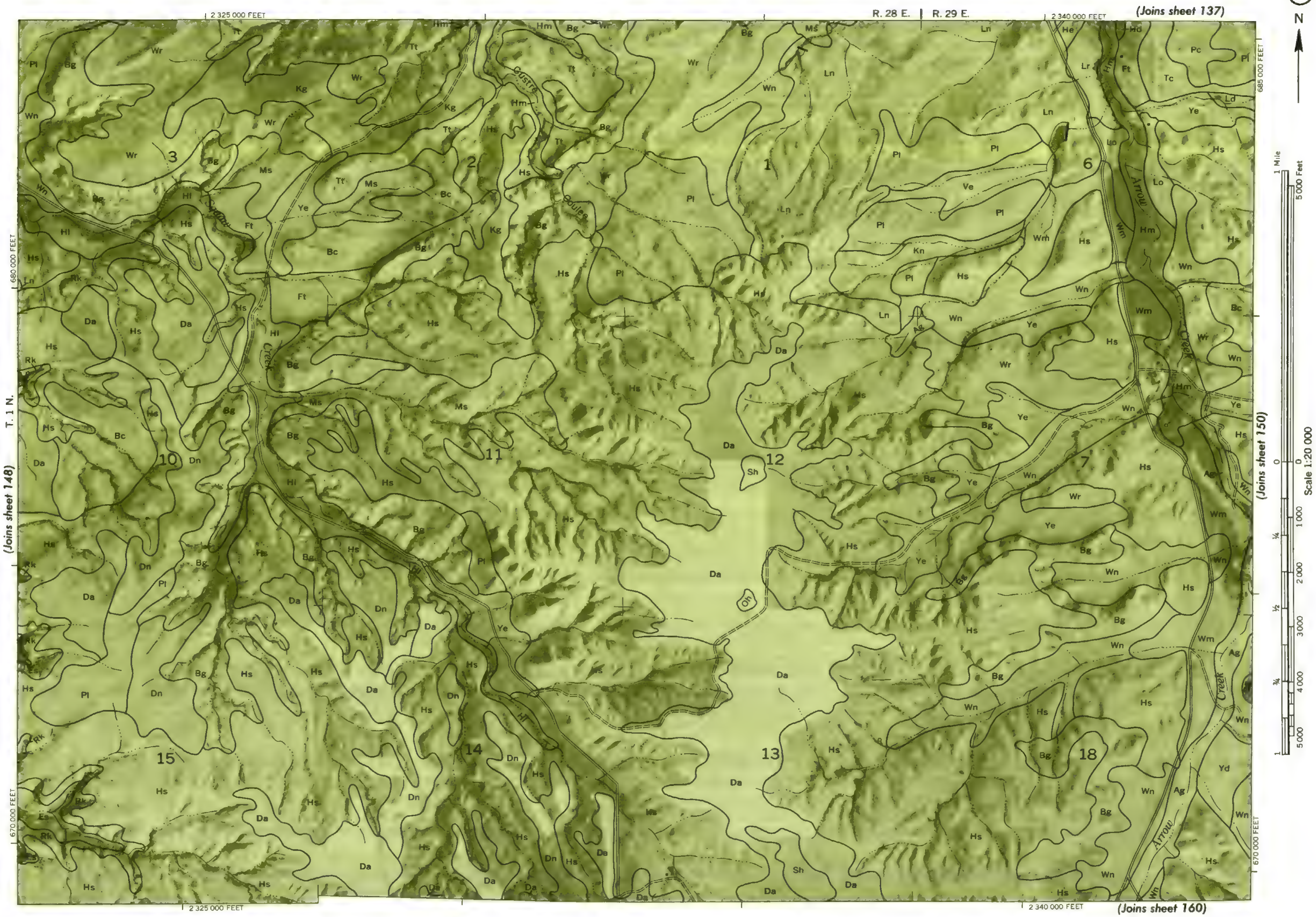
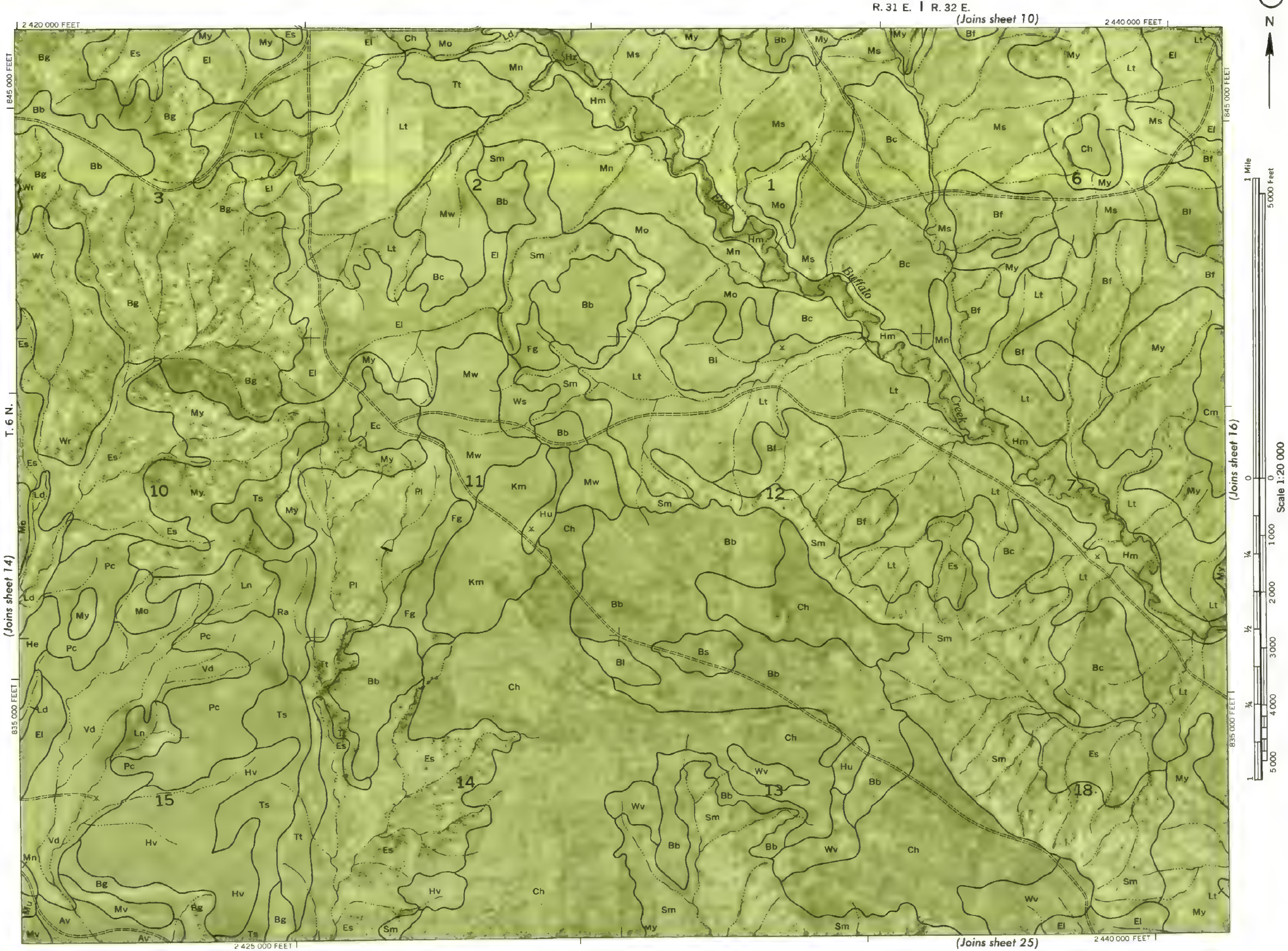


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

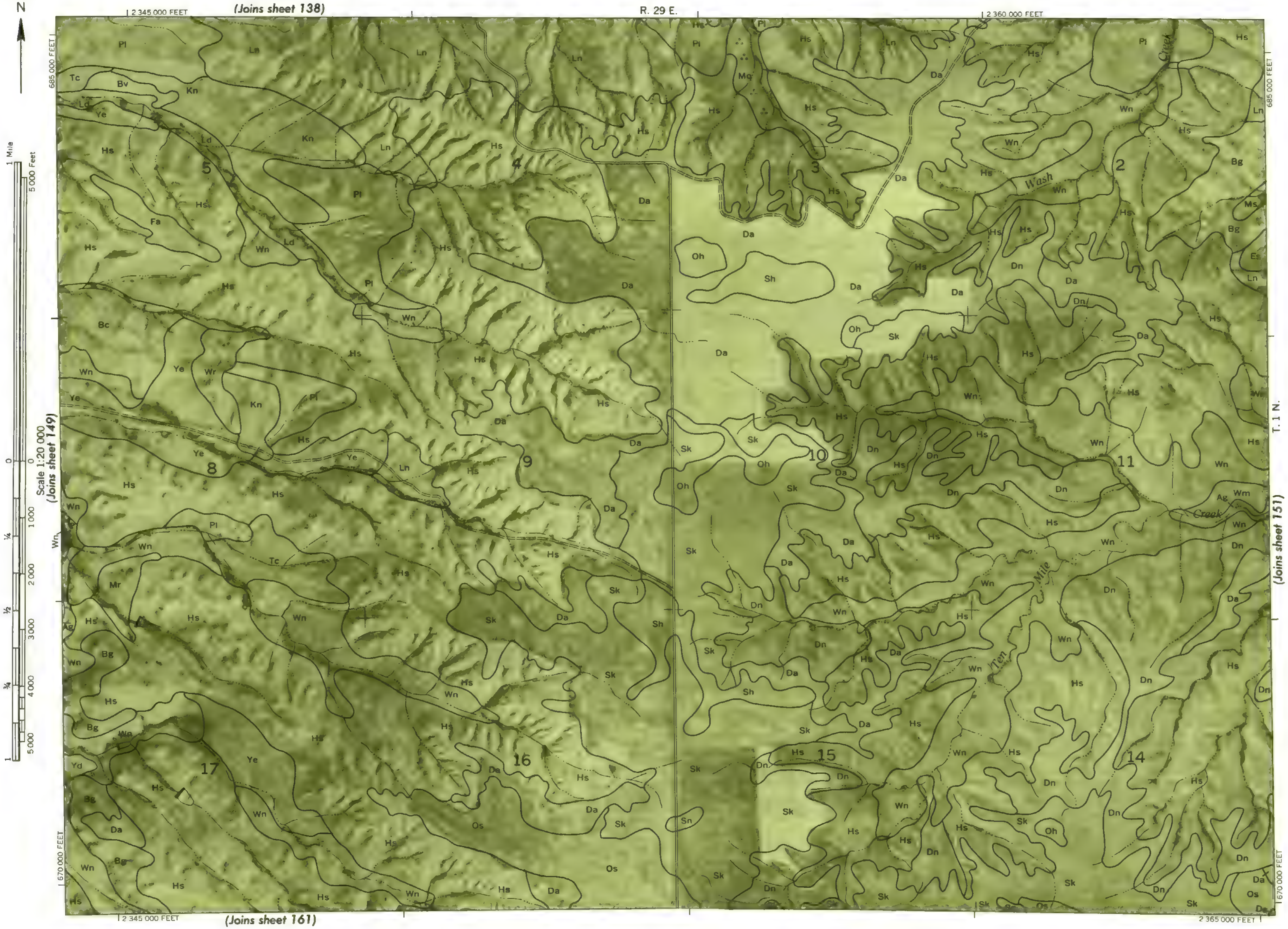
YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 15



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 15

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



YELLOWSTONE COUNTY, MONTANA NO. 150

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

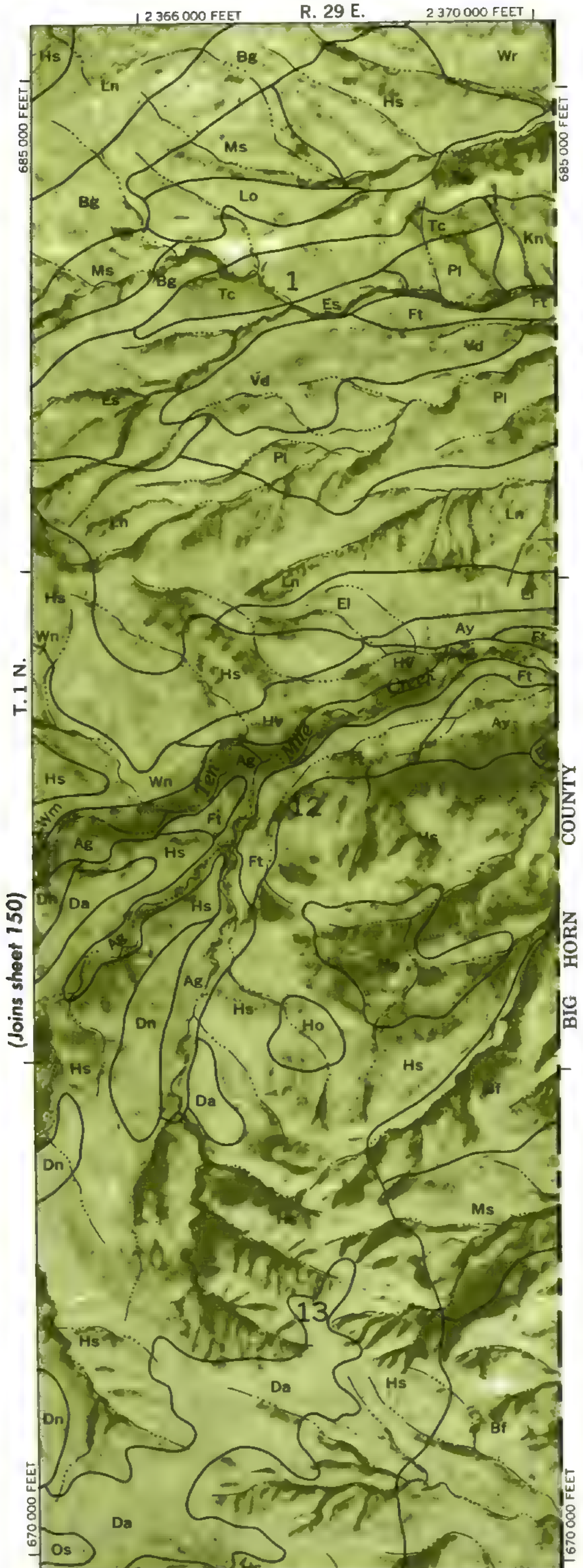
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

151

N

(Joins sheet 139)

2 366 000 FEET R. 29 E. 2 370 000 FEET



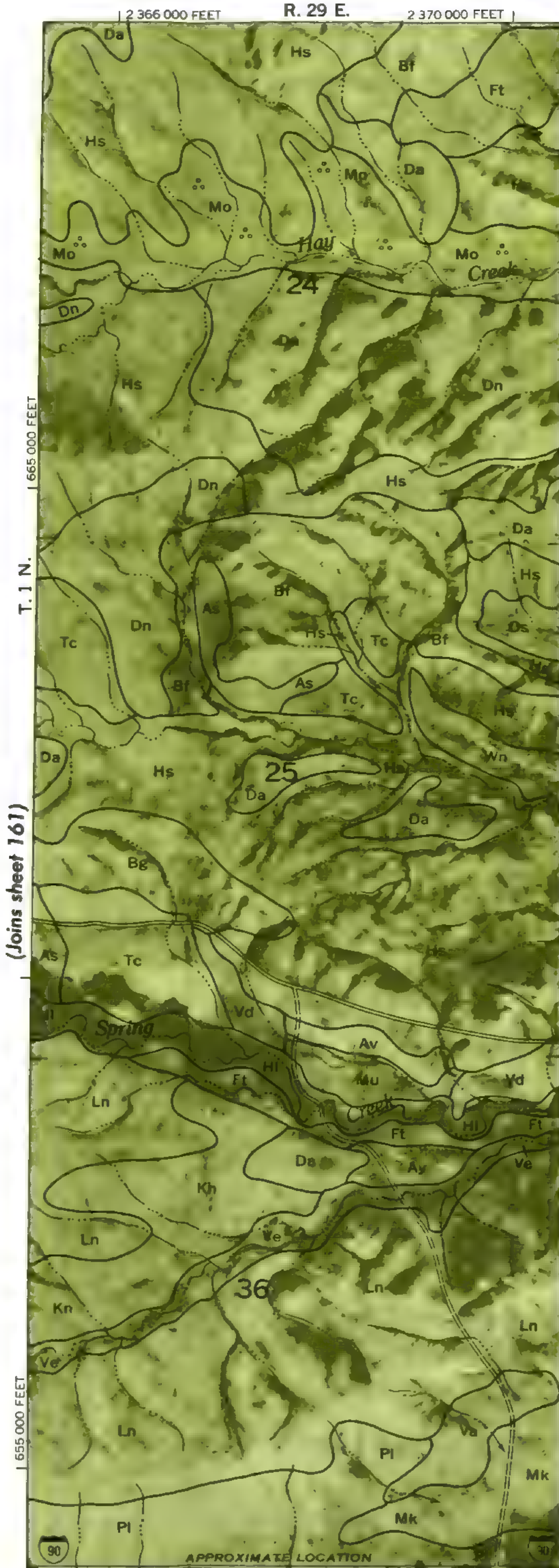
(Joins sheet 150)

2 366 000 FEET 2 370 000 FEET

(Joins upper right)

(Joins lower left)

2 366 000 FEET R. 29 E. 2 370 000 FEET



(Joins sheet 161)

2 366 000 FEET 2 370 000 FEET

BIG HORN COUNTY

Scale 1:20 000

1 Mile, ¾, ½, ¼, 0

5 000 Feet, 4 000, 3 000, 2000, 1000, 0

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

GRID TICK INTERVAL 4000 FEET ON EAST-WEST LINE

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 152

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 152

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 153

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 154

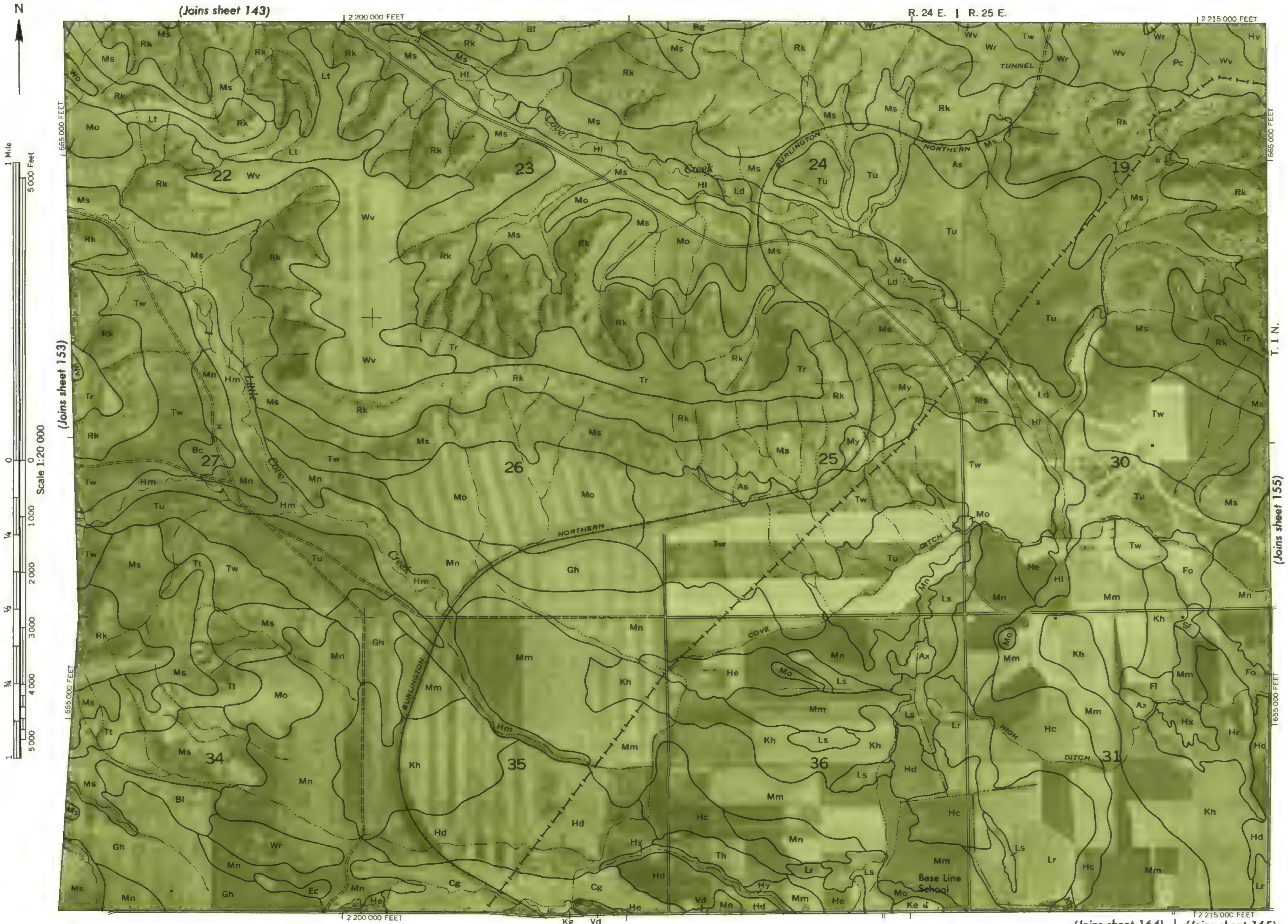


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 154

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.
YELLOWSTONE COUNTY, MONTANA NO. 155

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 156

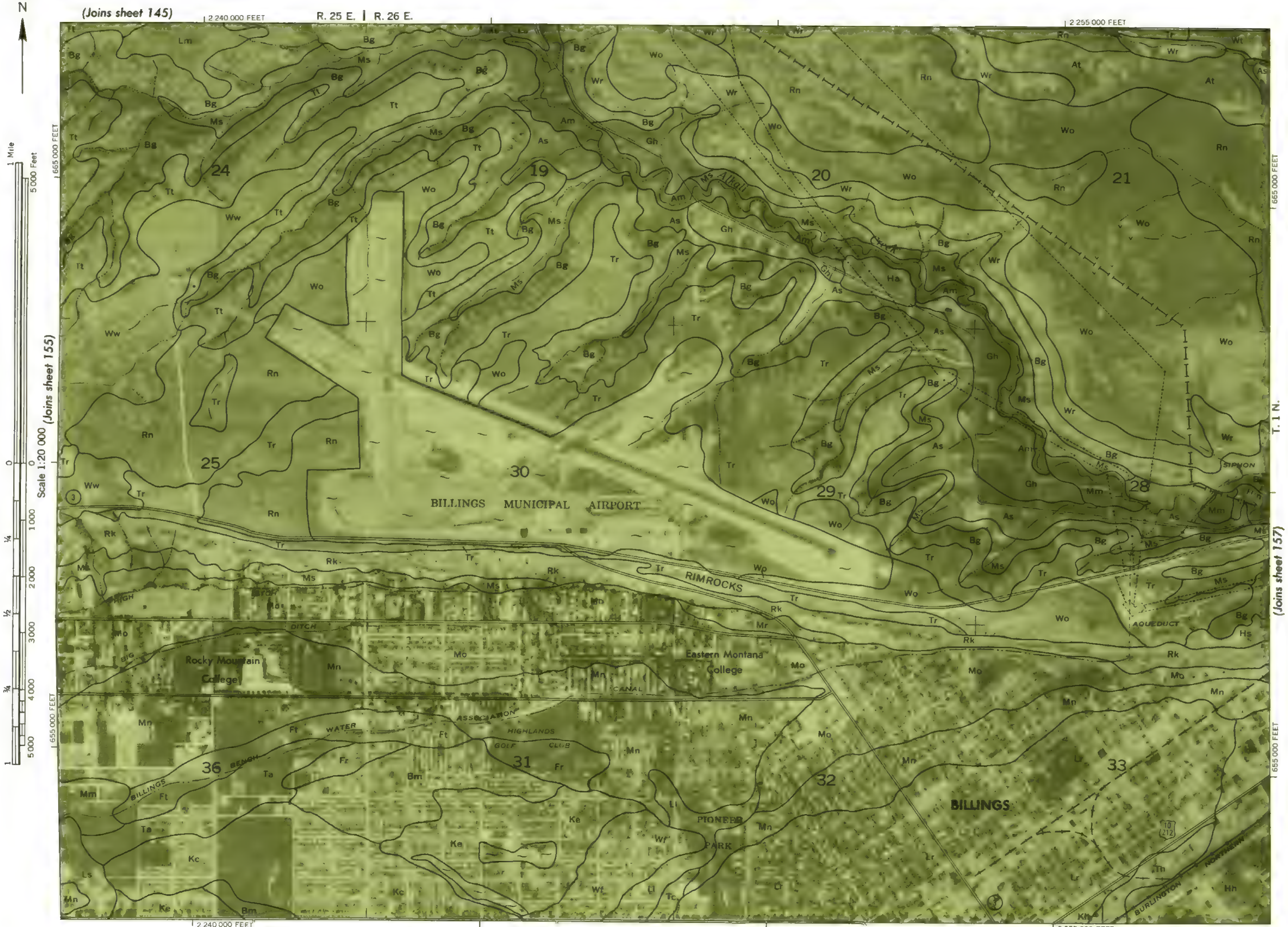
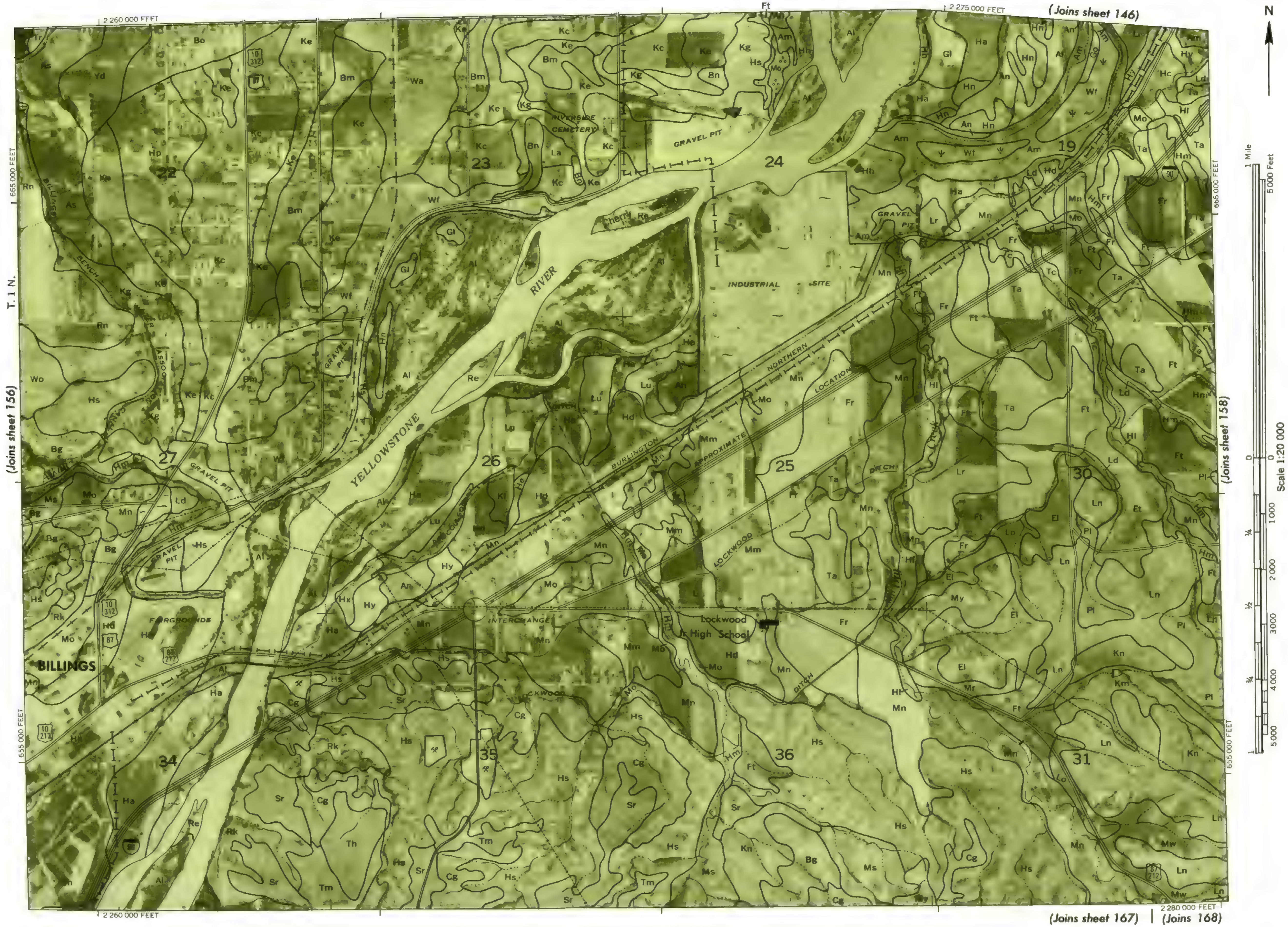


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 156

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 157

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 158

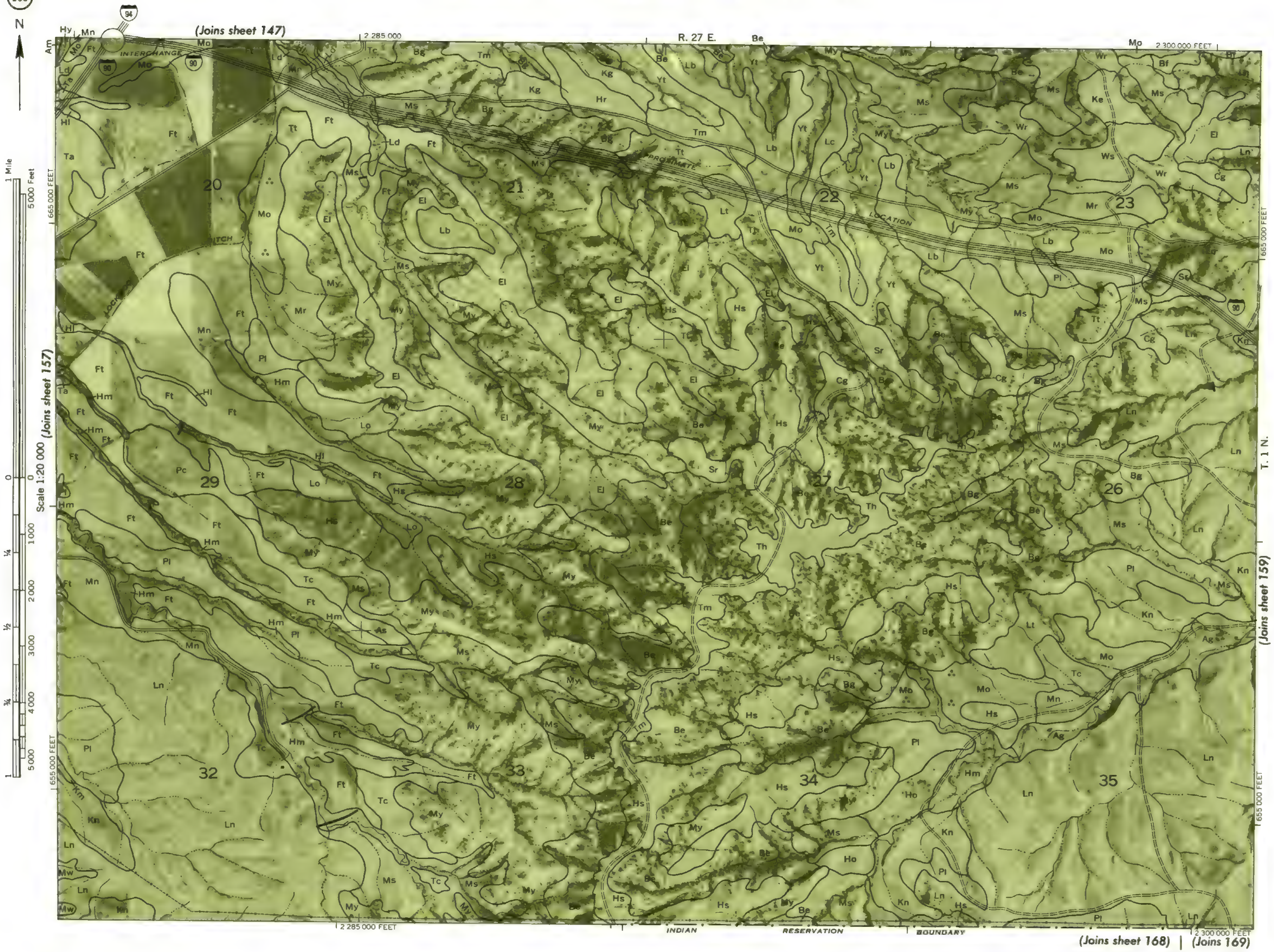


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 158

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

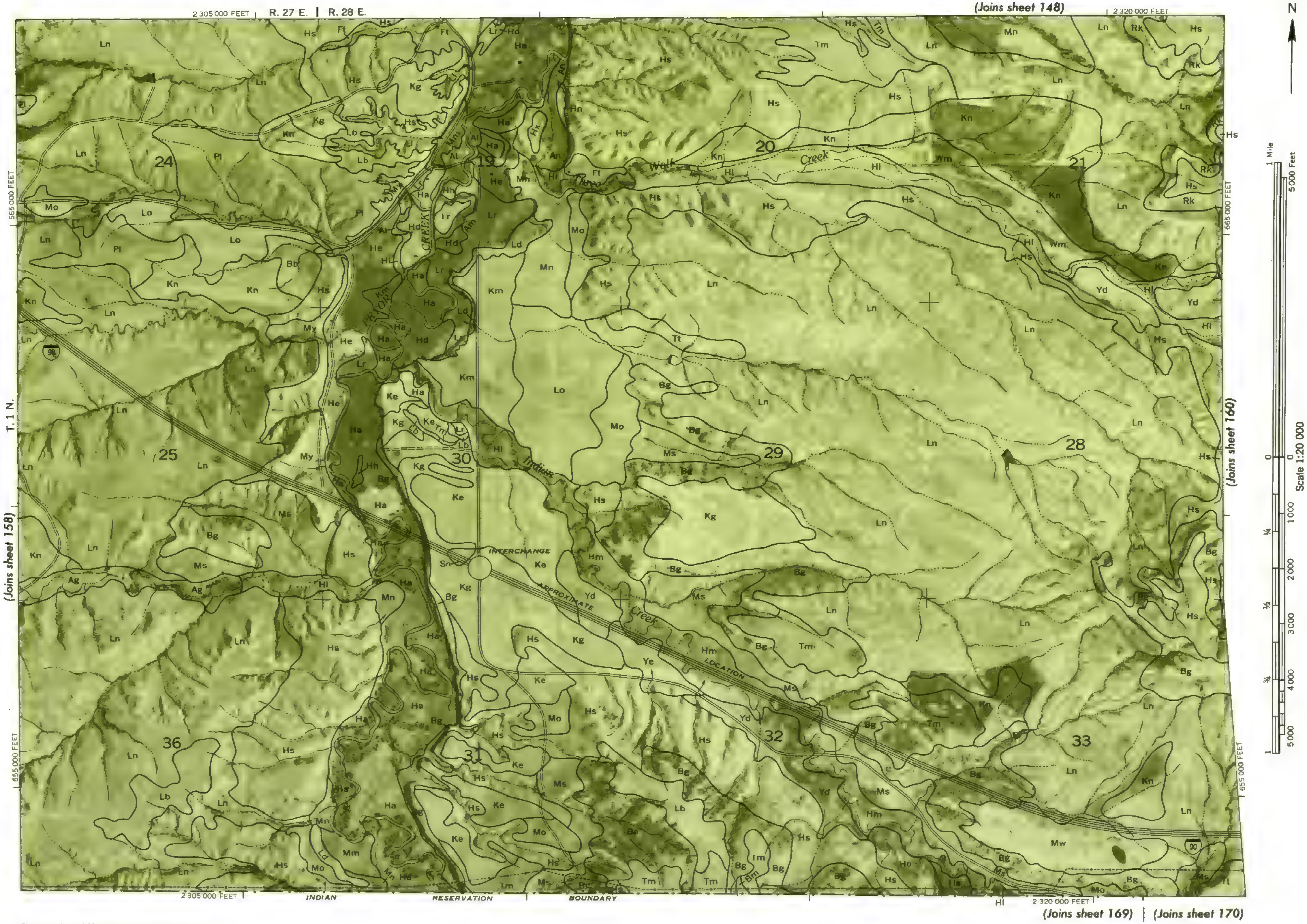


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

(16)

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 16

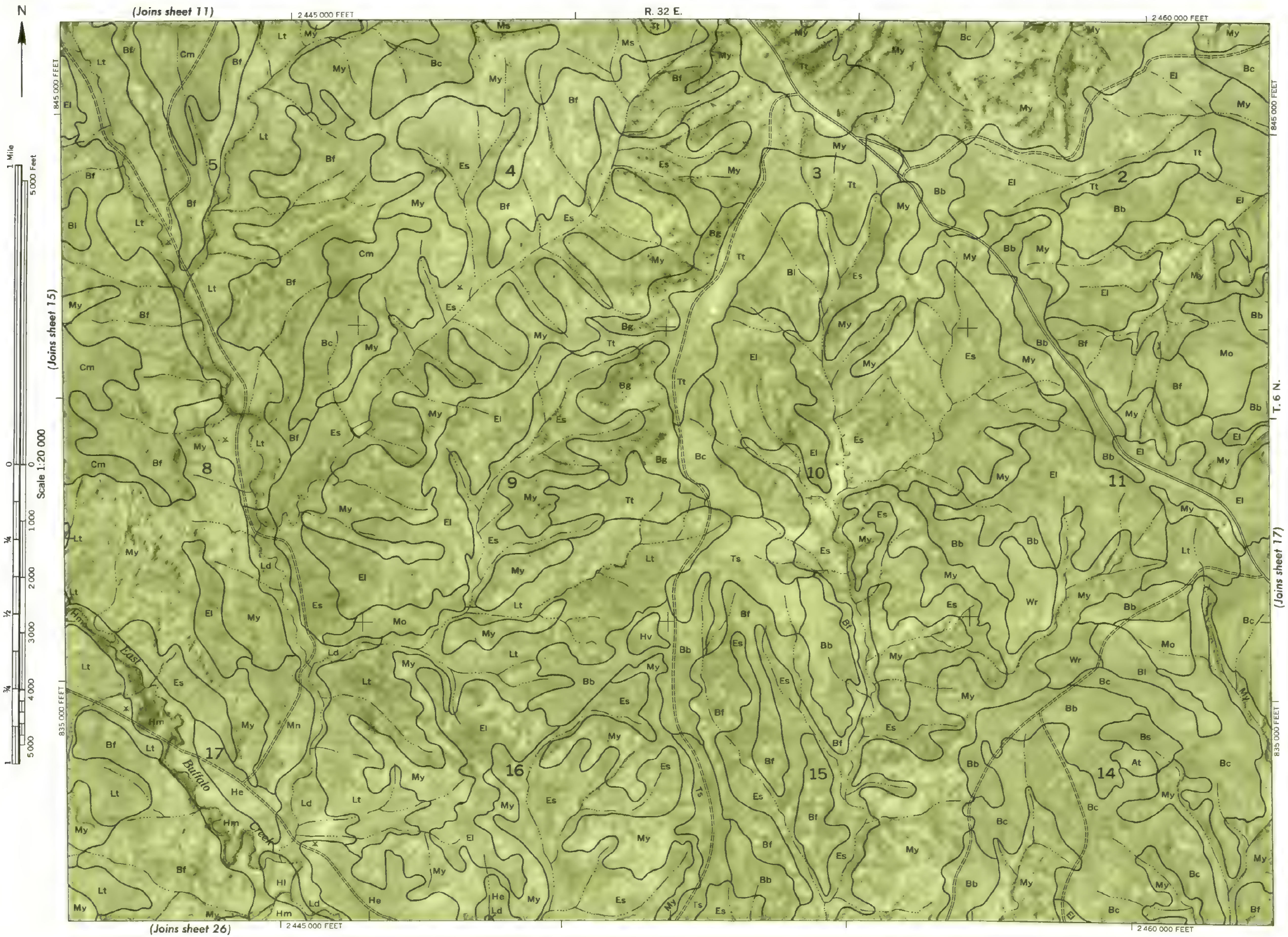


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 16

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 160

YELLOWSTONE COUNTY, MONTANA NO. 160

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

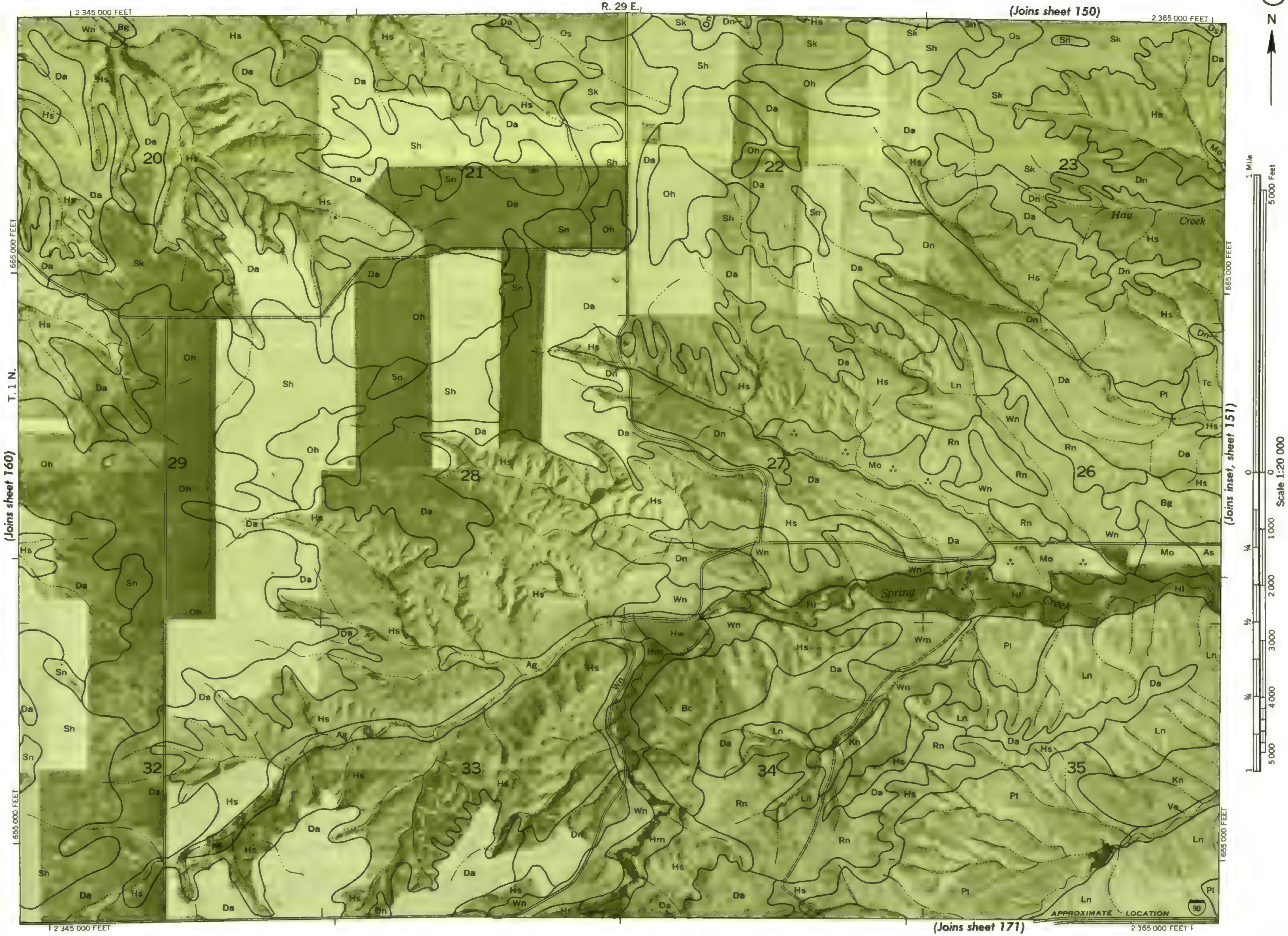


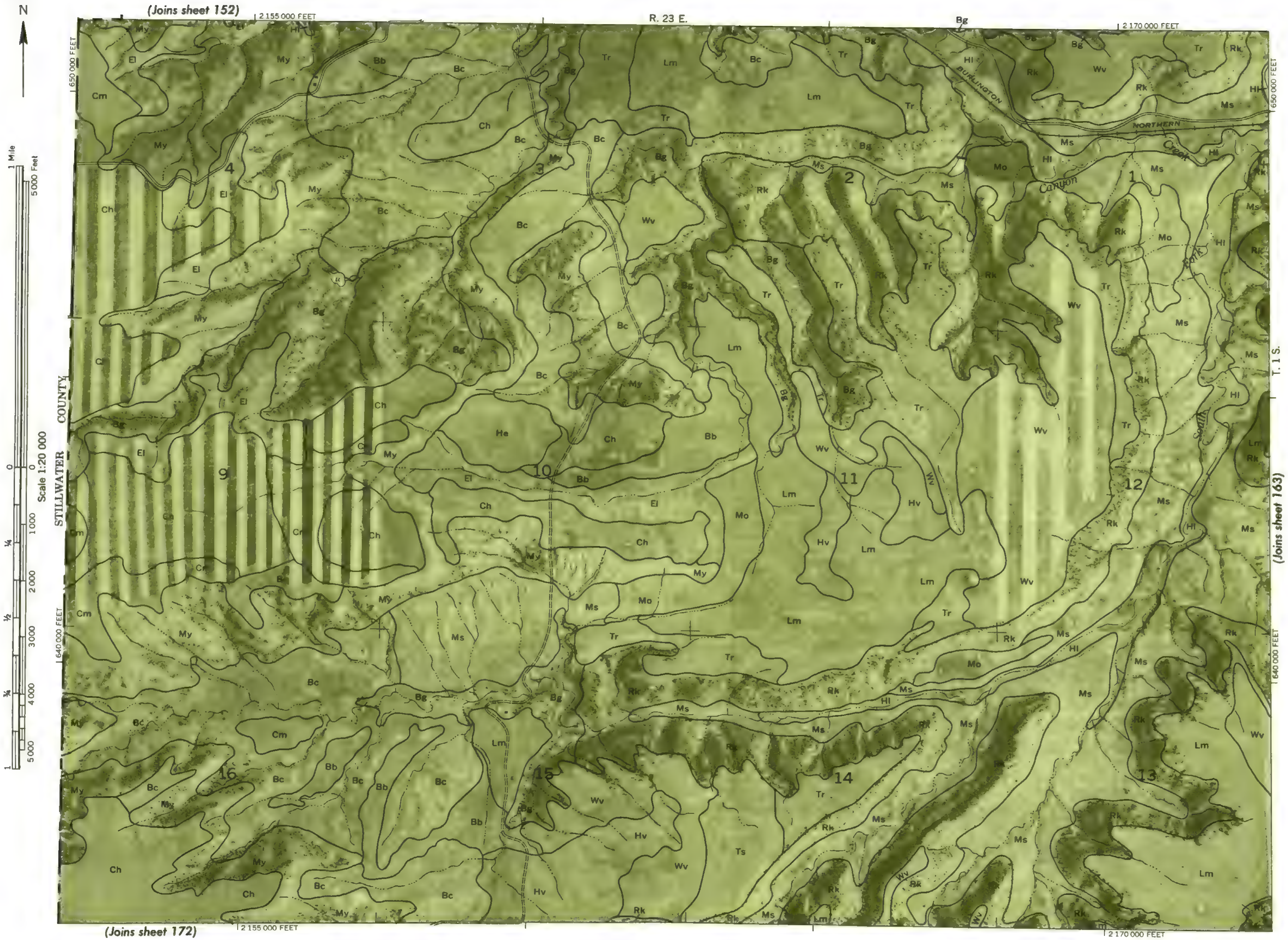
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 161

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 162



YELLOWSTONE COUNTY, MONTANA NO. 162

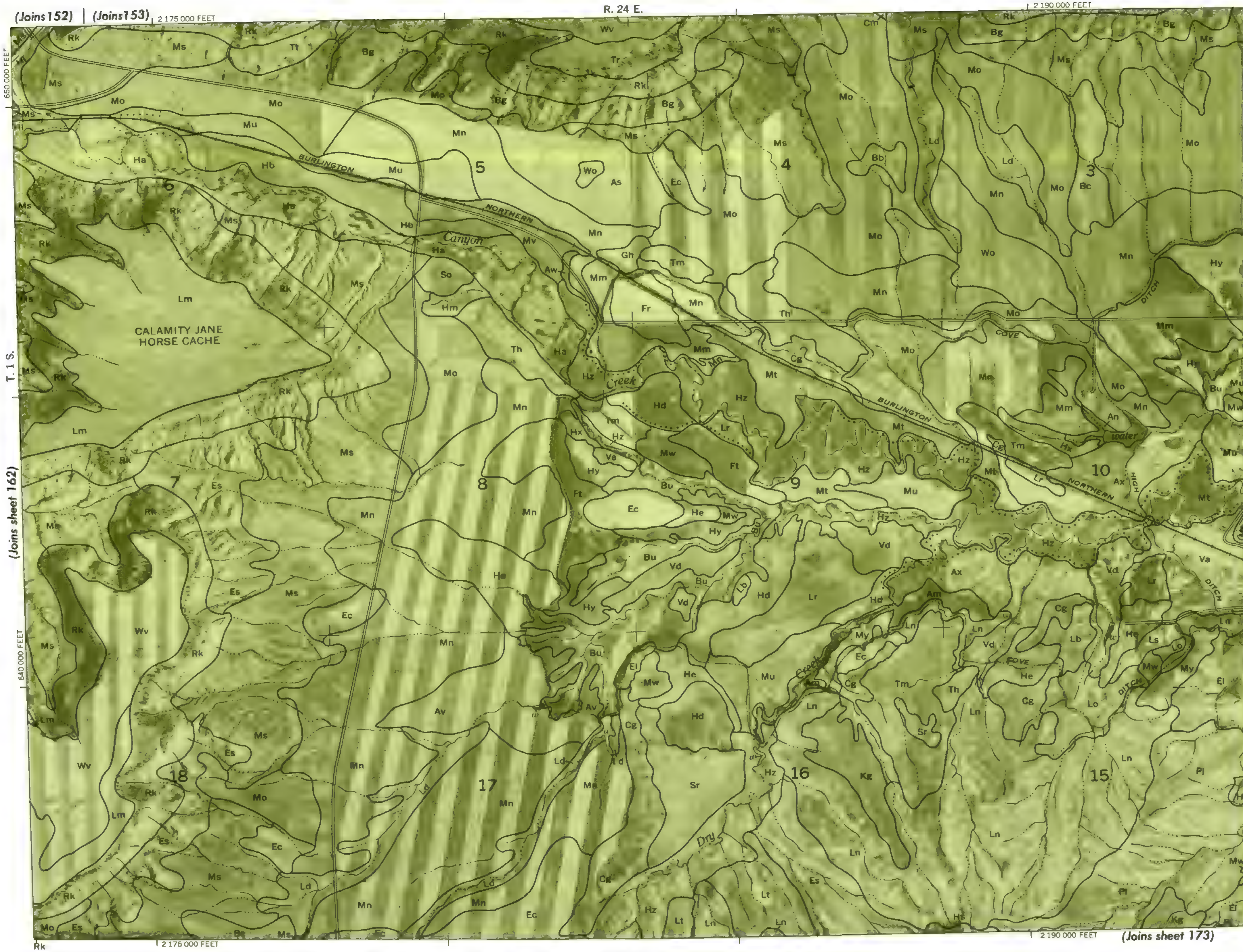
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 163



N

Scale 1:20 000

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

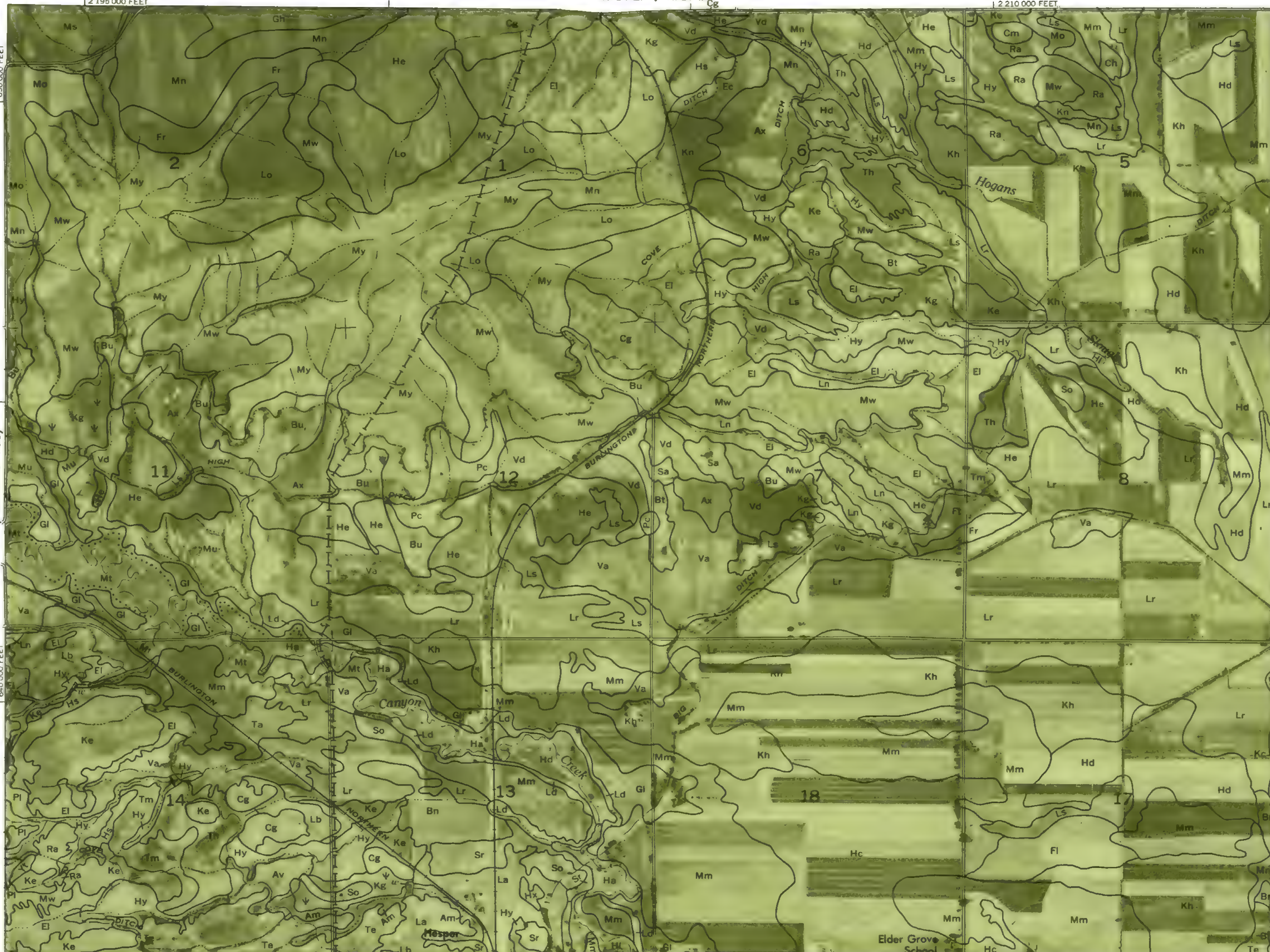
YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 164

(Joins 153) | (Joins sheet 154)

R. 24 E. | R. 25 E.

2 195 000 FEET   2 210 000 FEET

N



1 Mile
5 000 Feet
Scale 1:20 000
0 1 000 2 000 3 000 4 000 5 000
0 ¼ ½ ¾ 1

(Joins sheet 163)

(Joins sheet 165)

T. 1 S.

650 000 FEET
640 000 FEET

2 195 000 FEET   (Joins sheet 174)   2 210 000 FEET

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 164

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

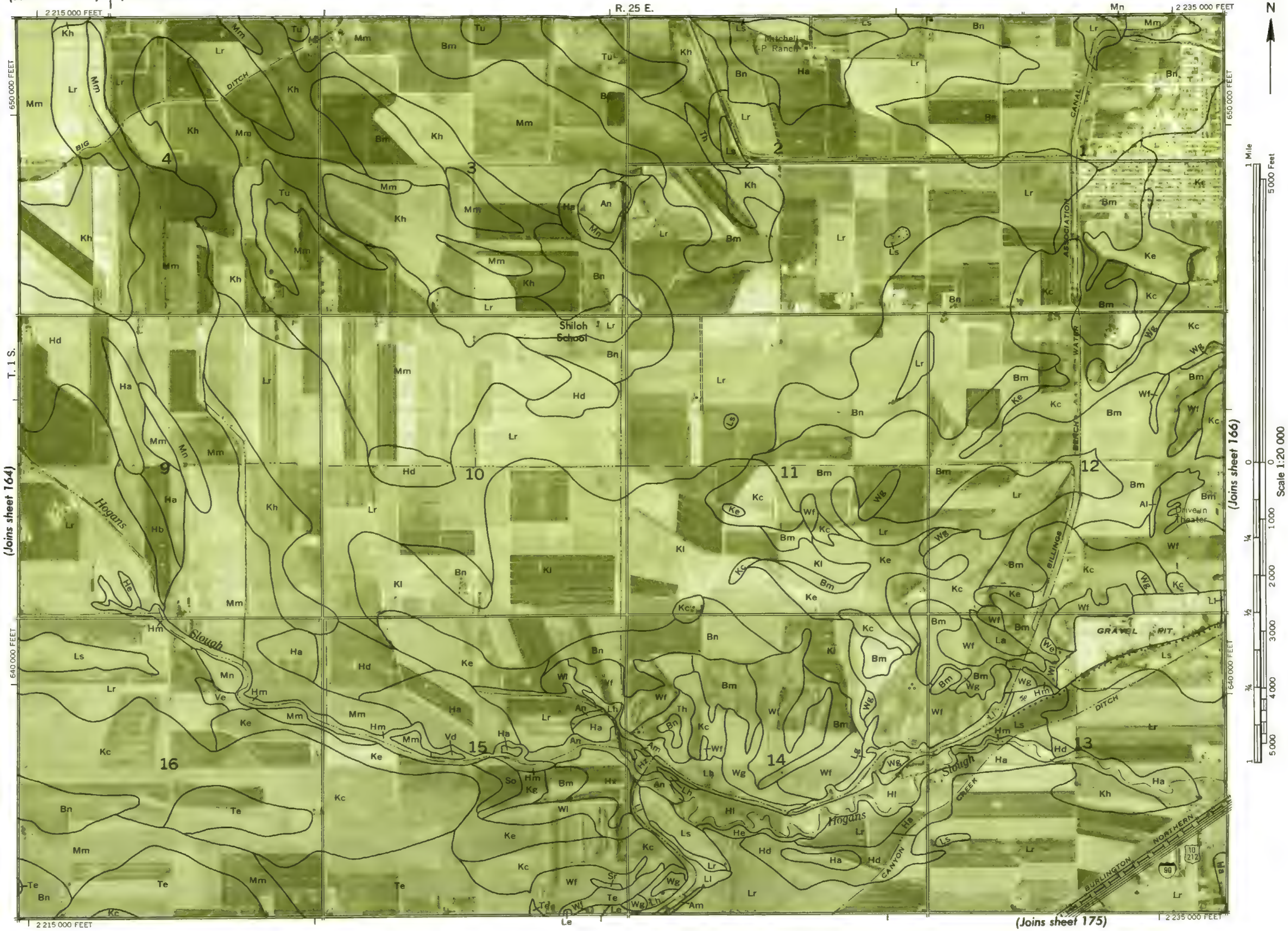
YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 165

165

(Joins sheet 154) | (Joins sheet 155)

(Joins sheet 164)

(Joins sheet 166)



(Joins sheet 175)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 165

166

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 166

2 255 000 FEET

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 166

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

167

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 167

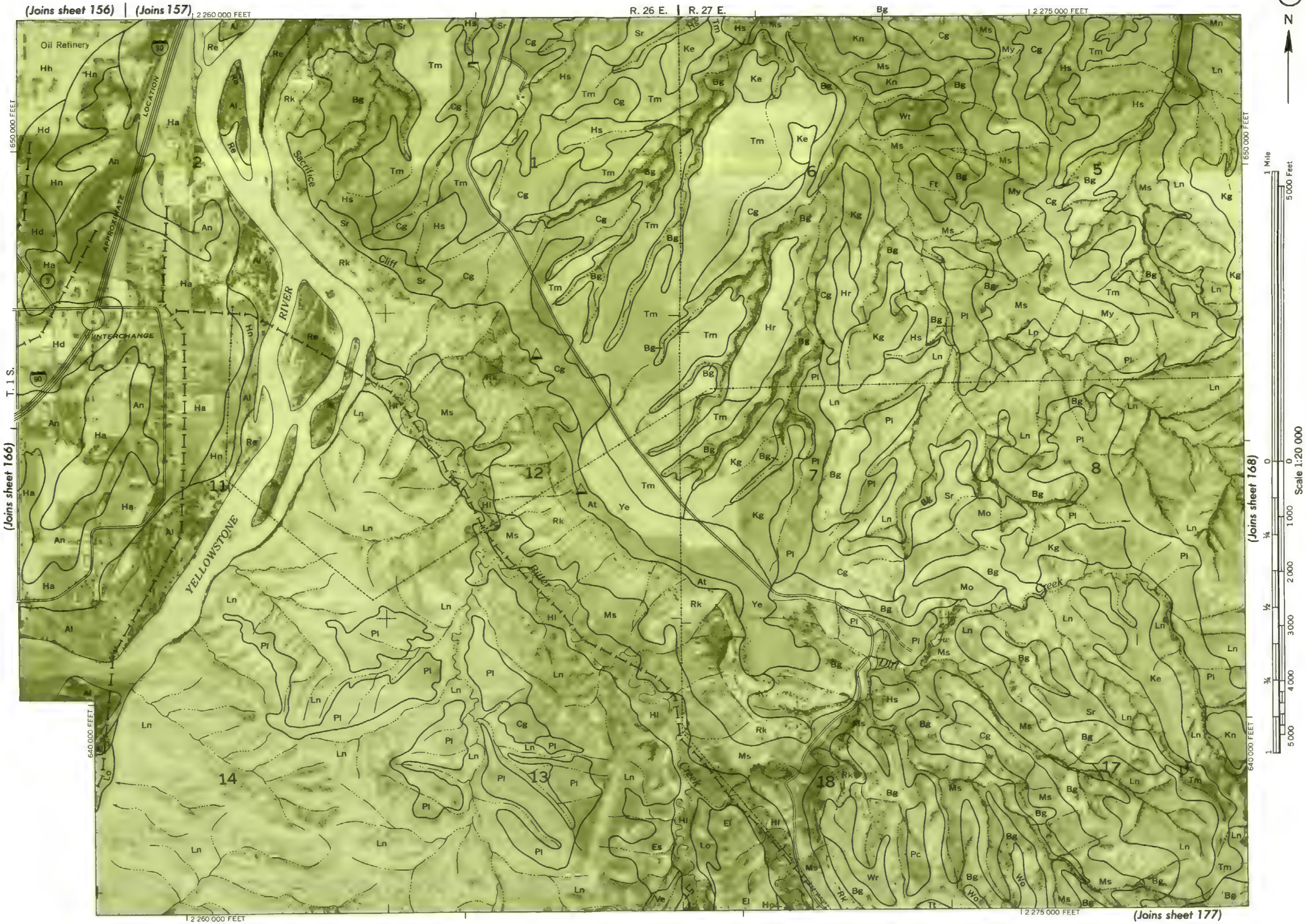


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 168

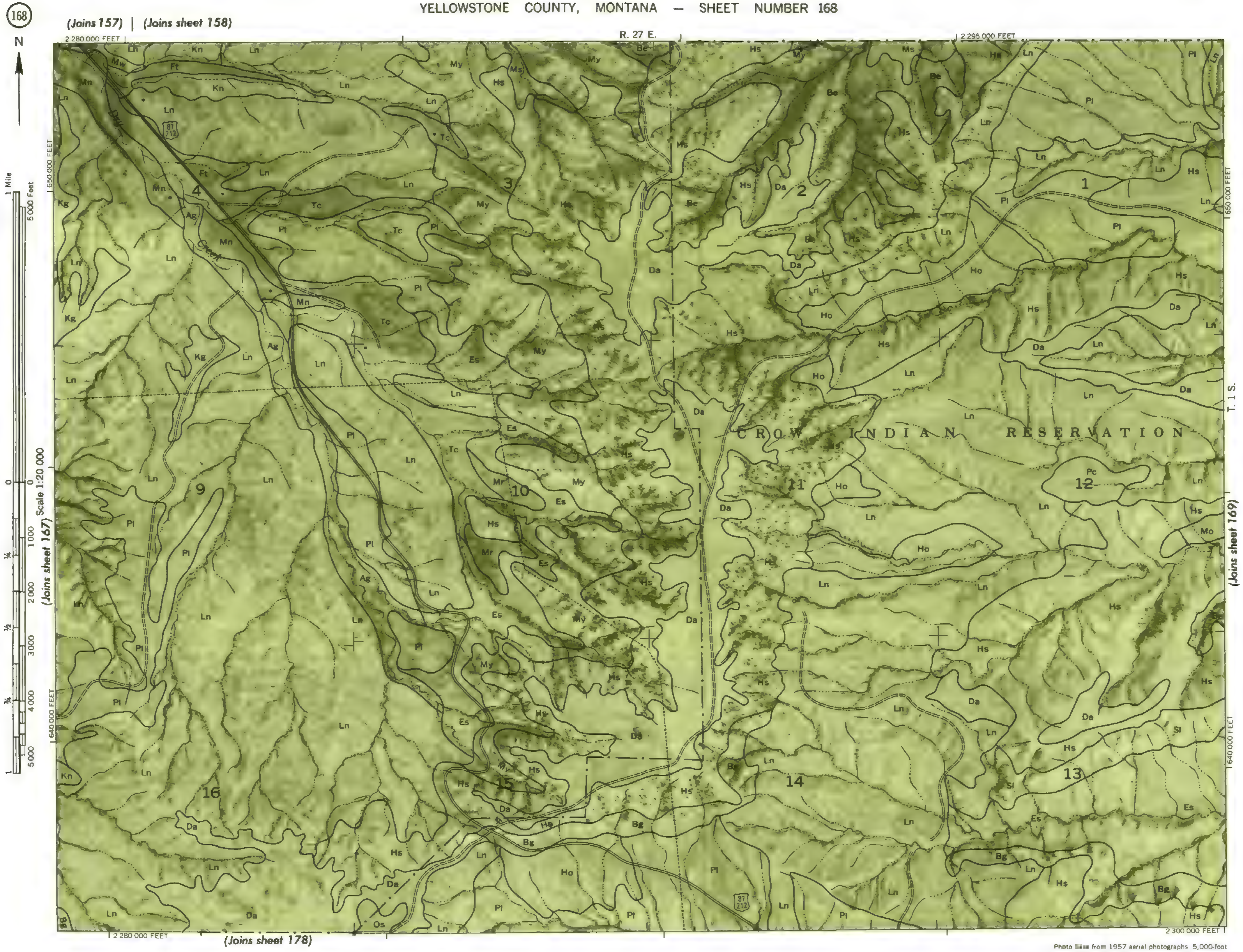


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 168

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

(Joins 158) | (Joins sheet 159)

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 169

169

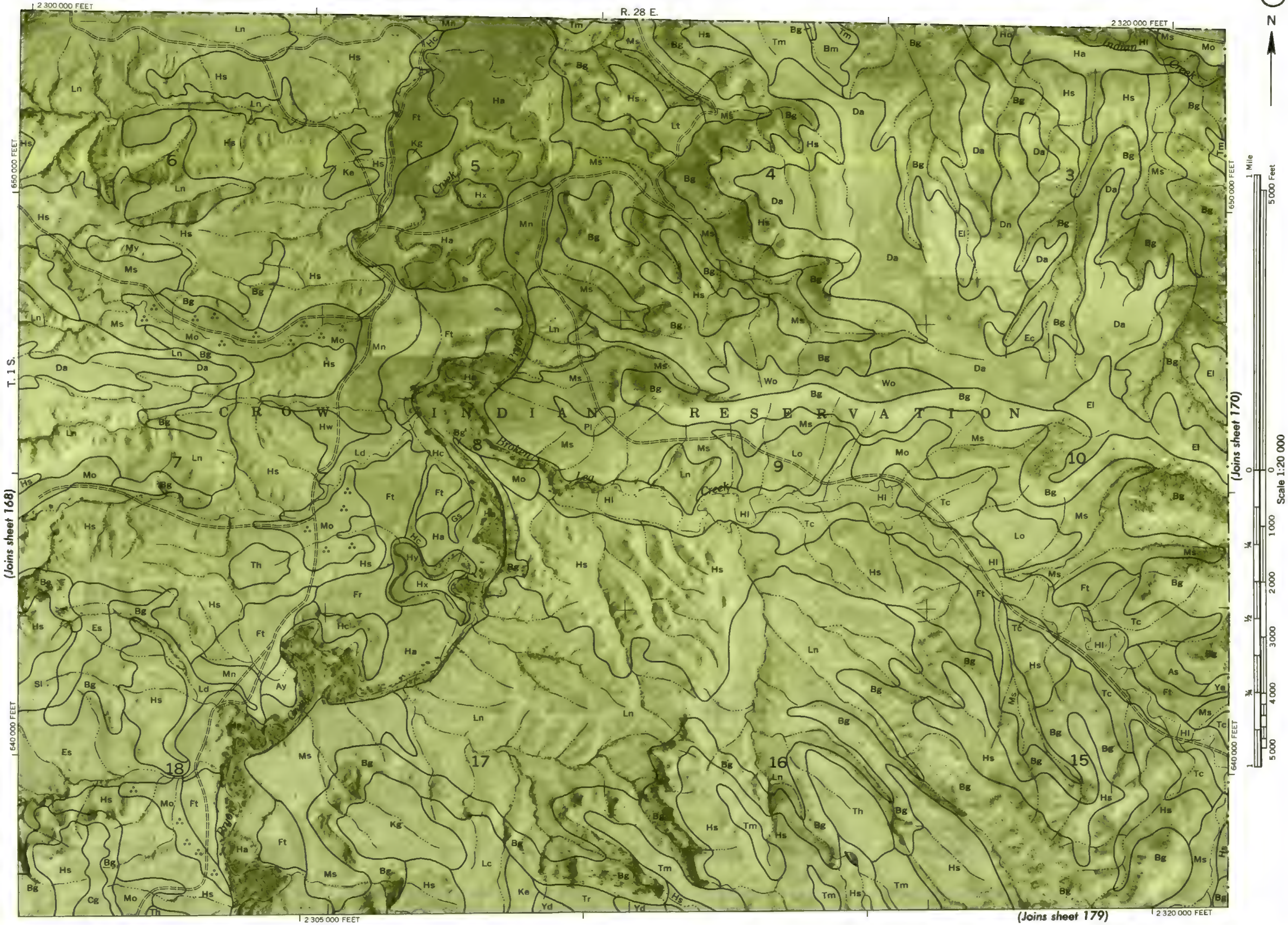


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 169

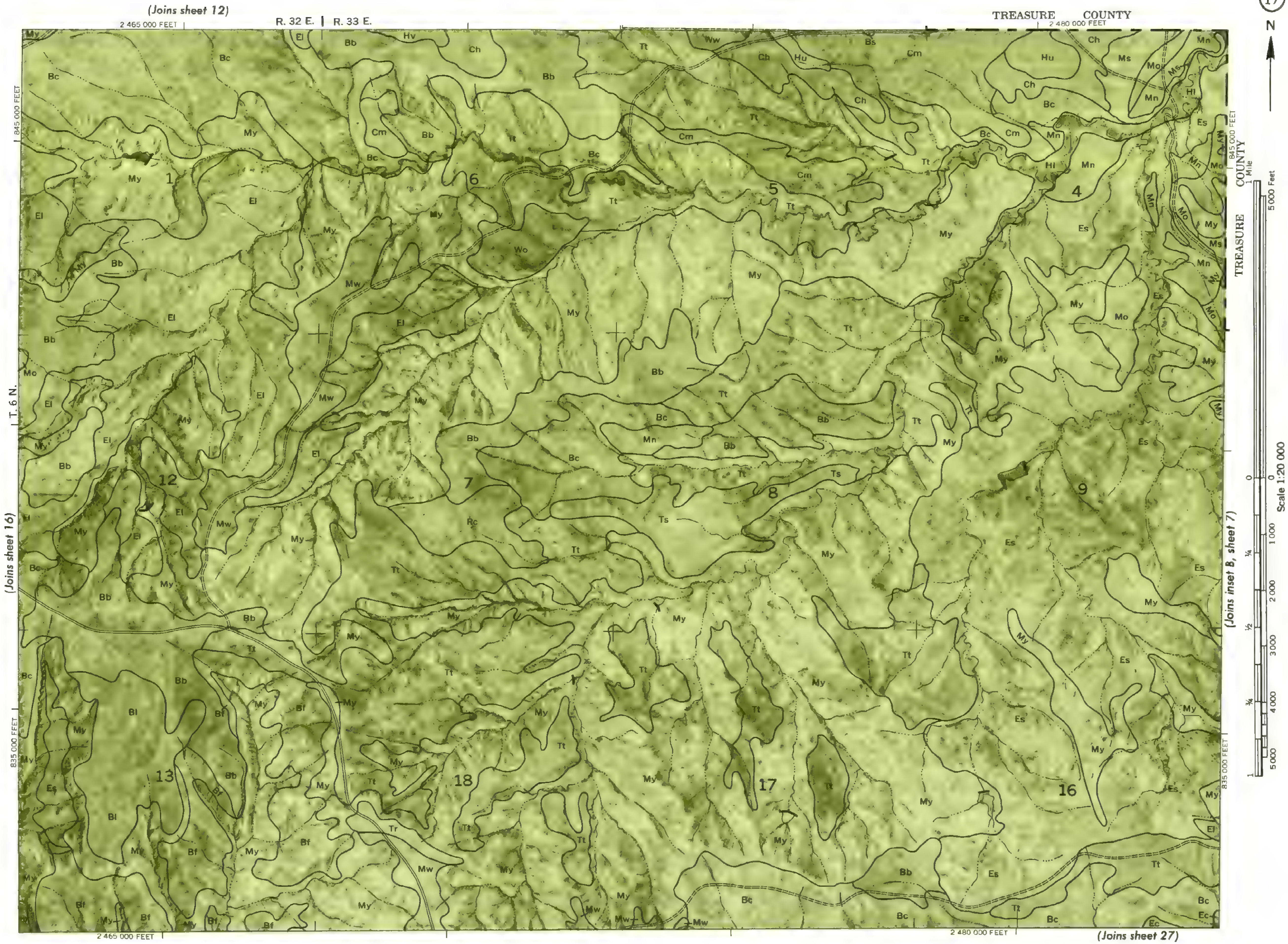


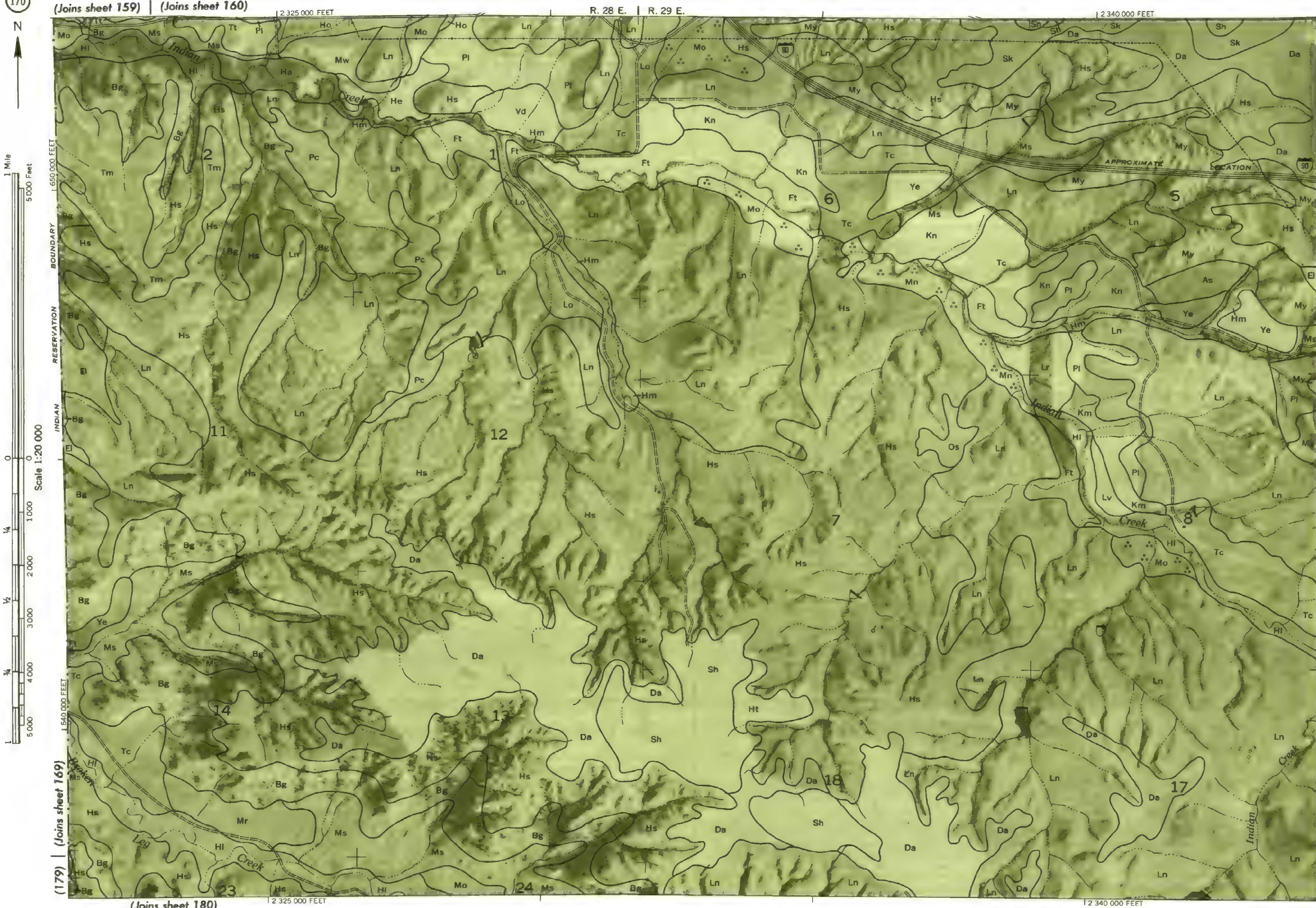
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 17

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 170



YELLOWSTONE COUNTY, MONTANA NO. 170

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 171

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 171

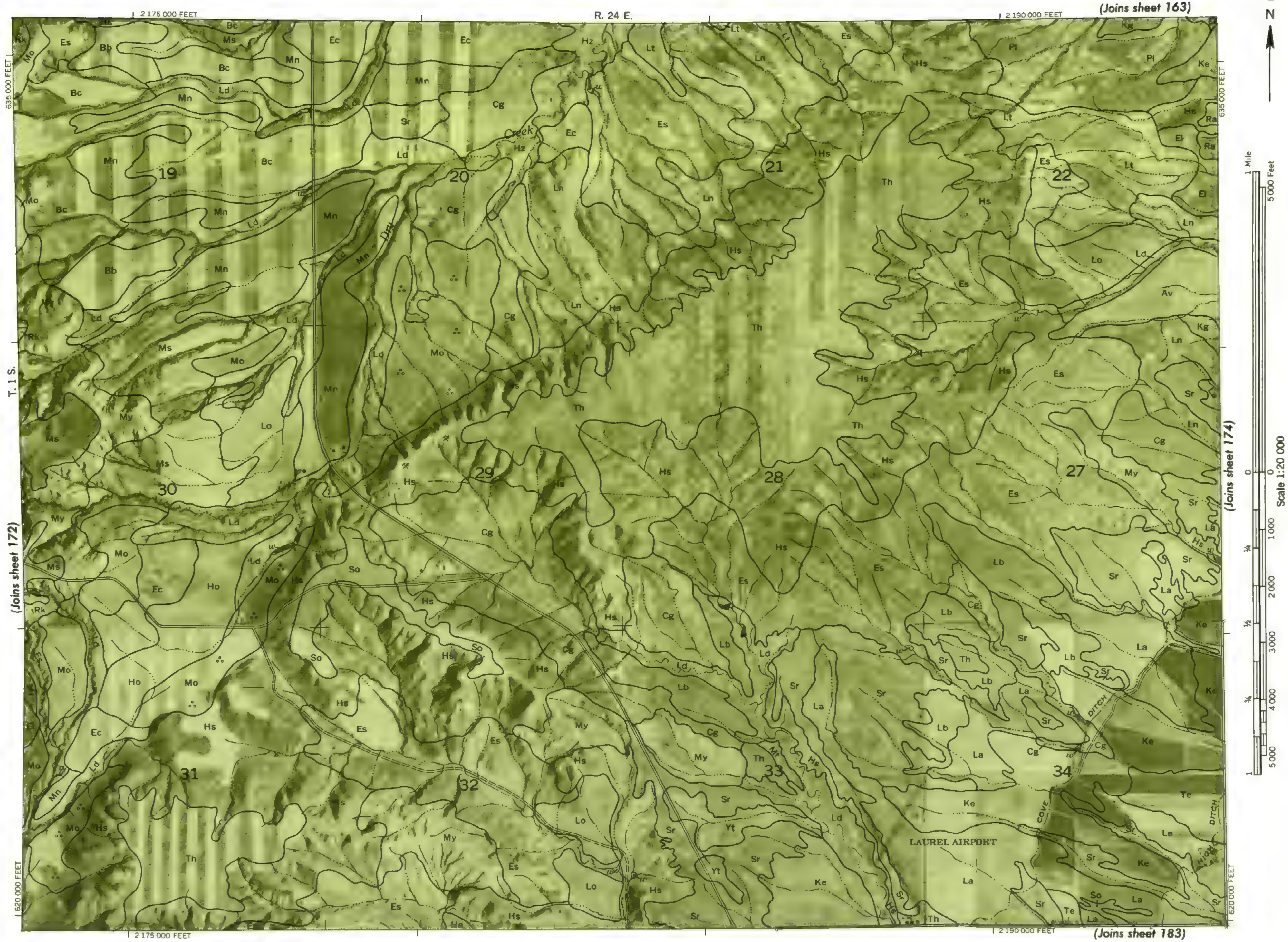
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 172

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 173

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 174

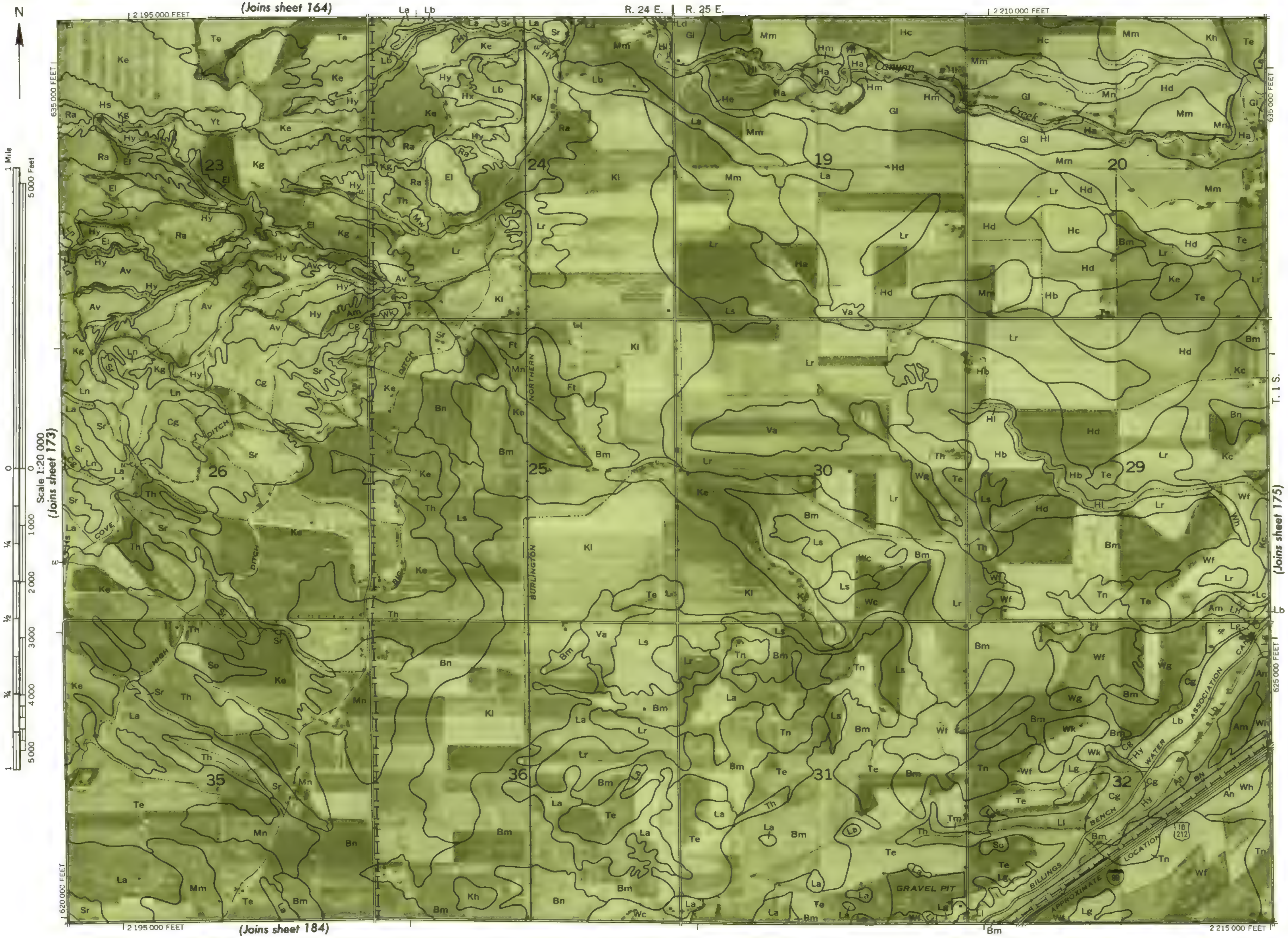


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 174

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

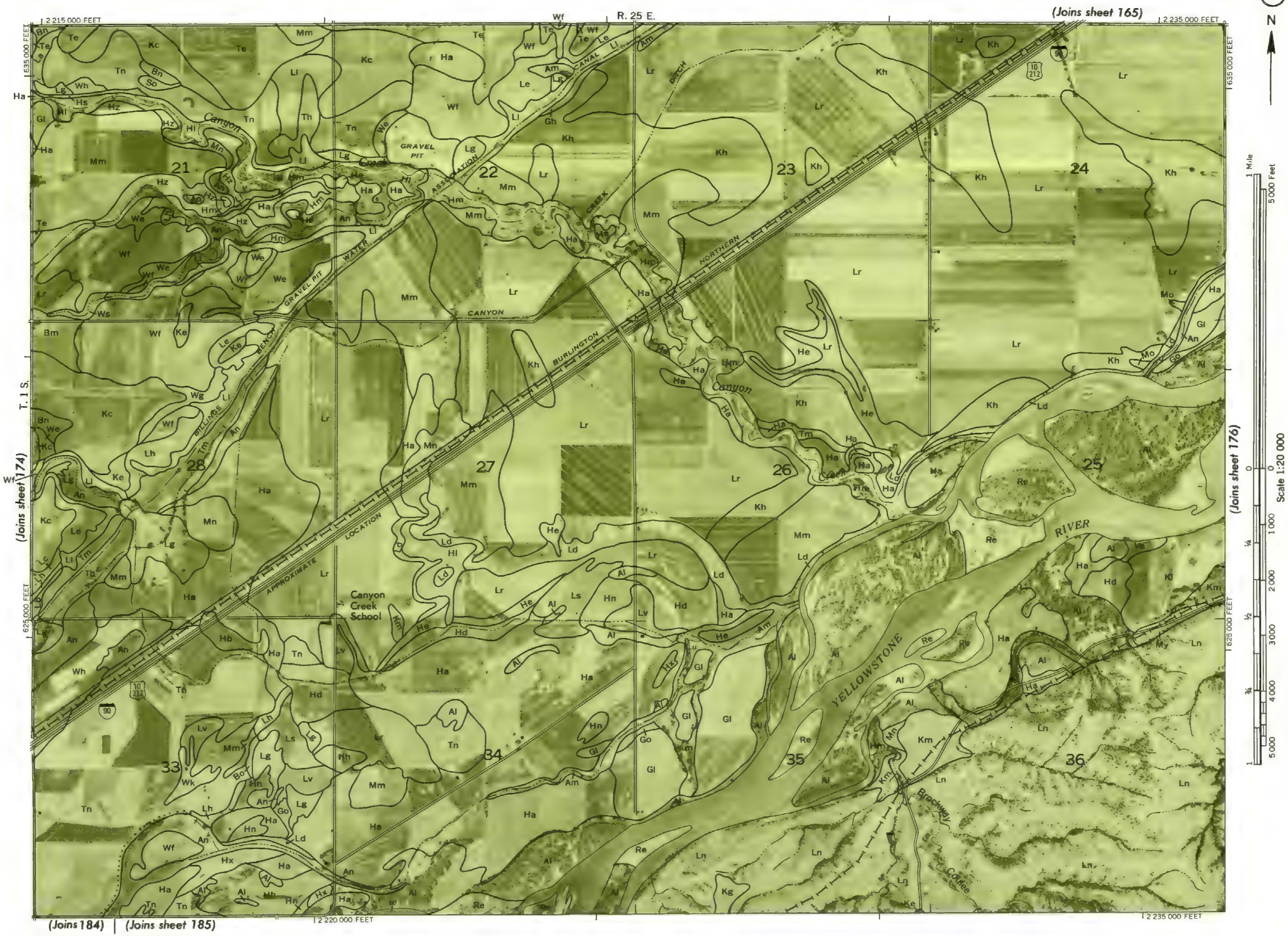


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 175

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 176

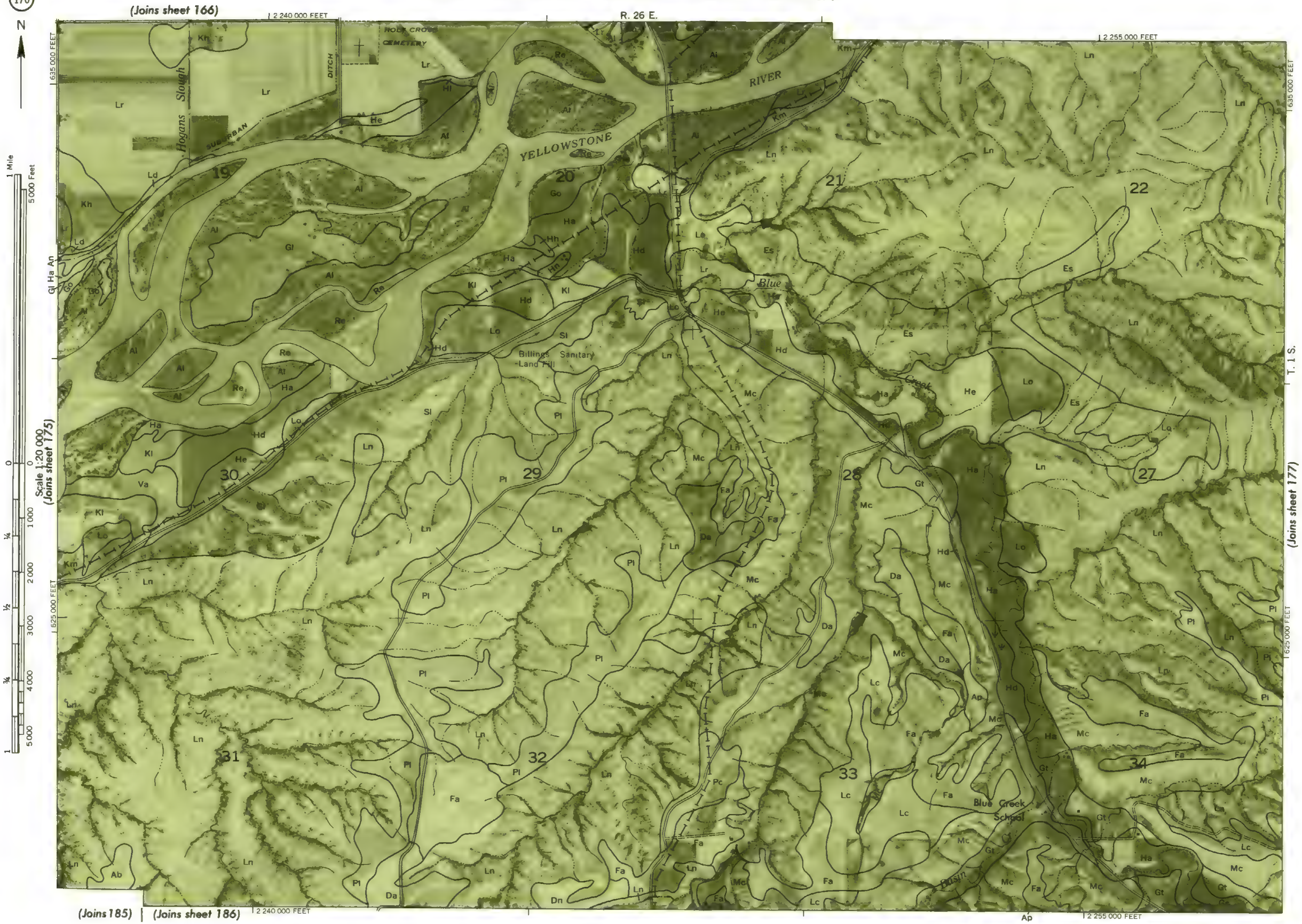


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 176

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 177

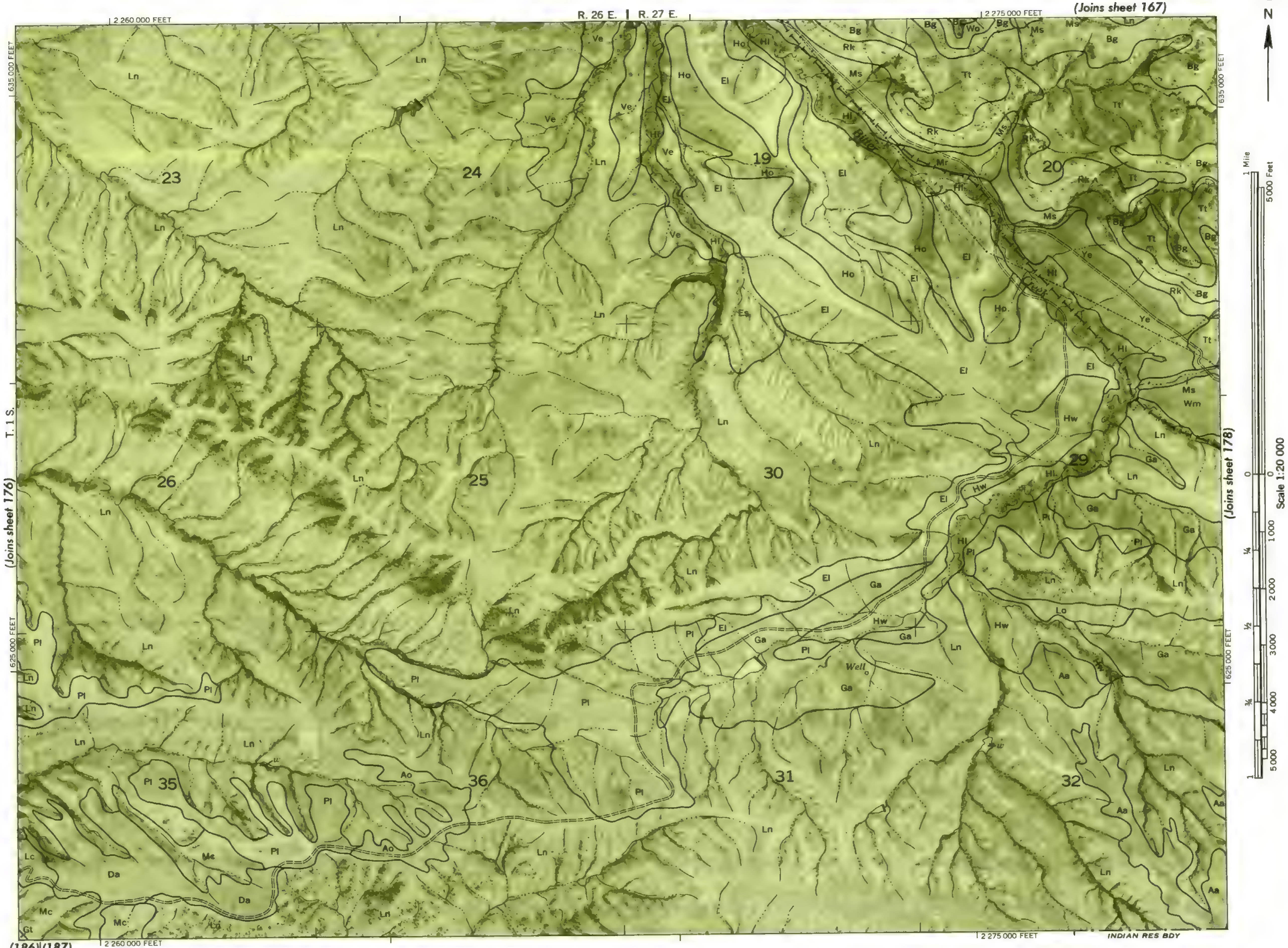


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

178

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 178

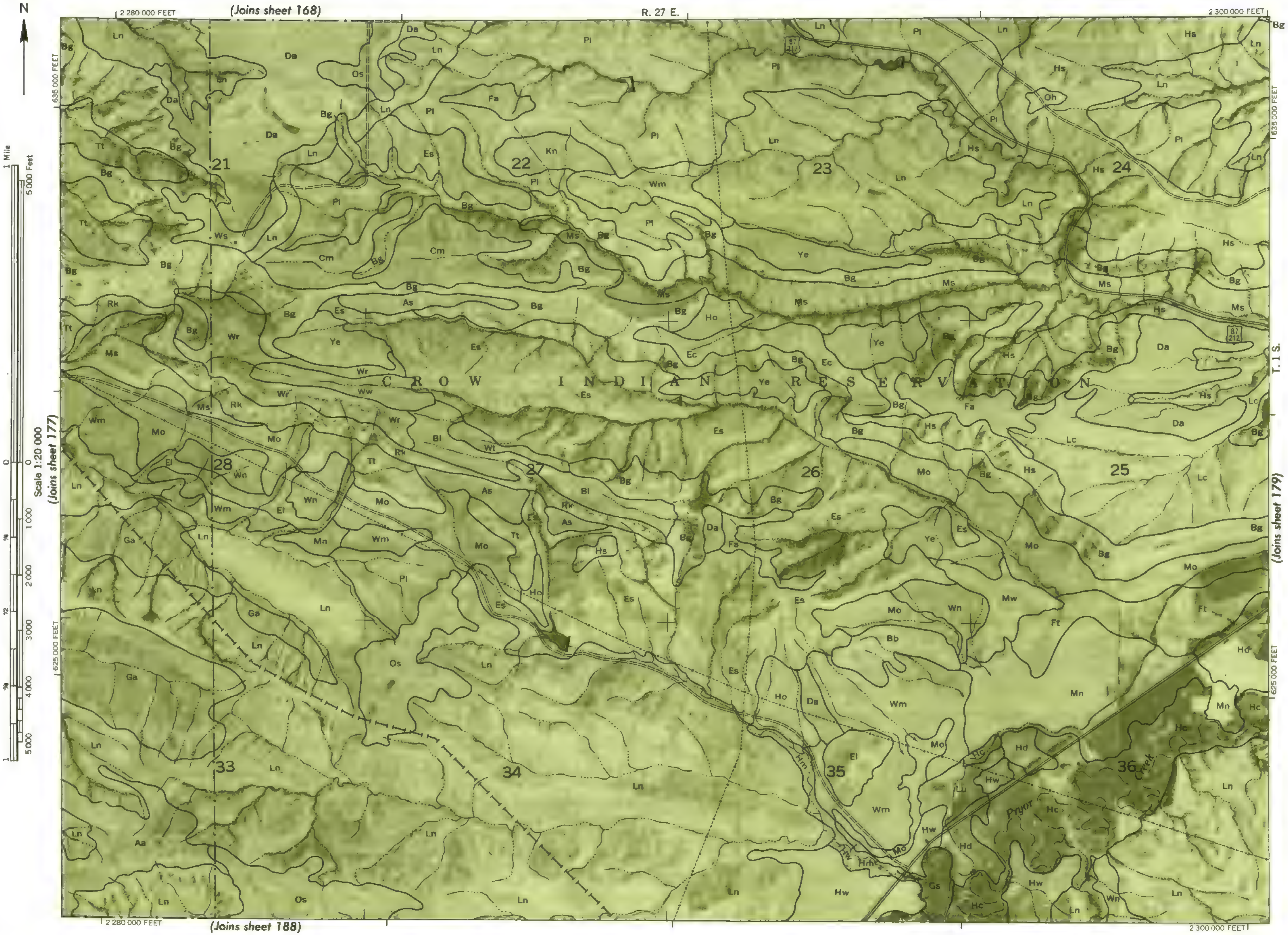


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 178

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

179

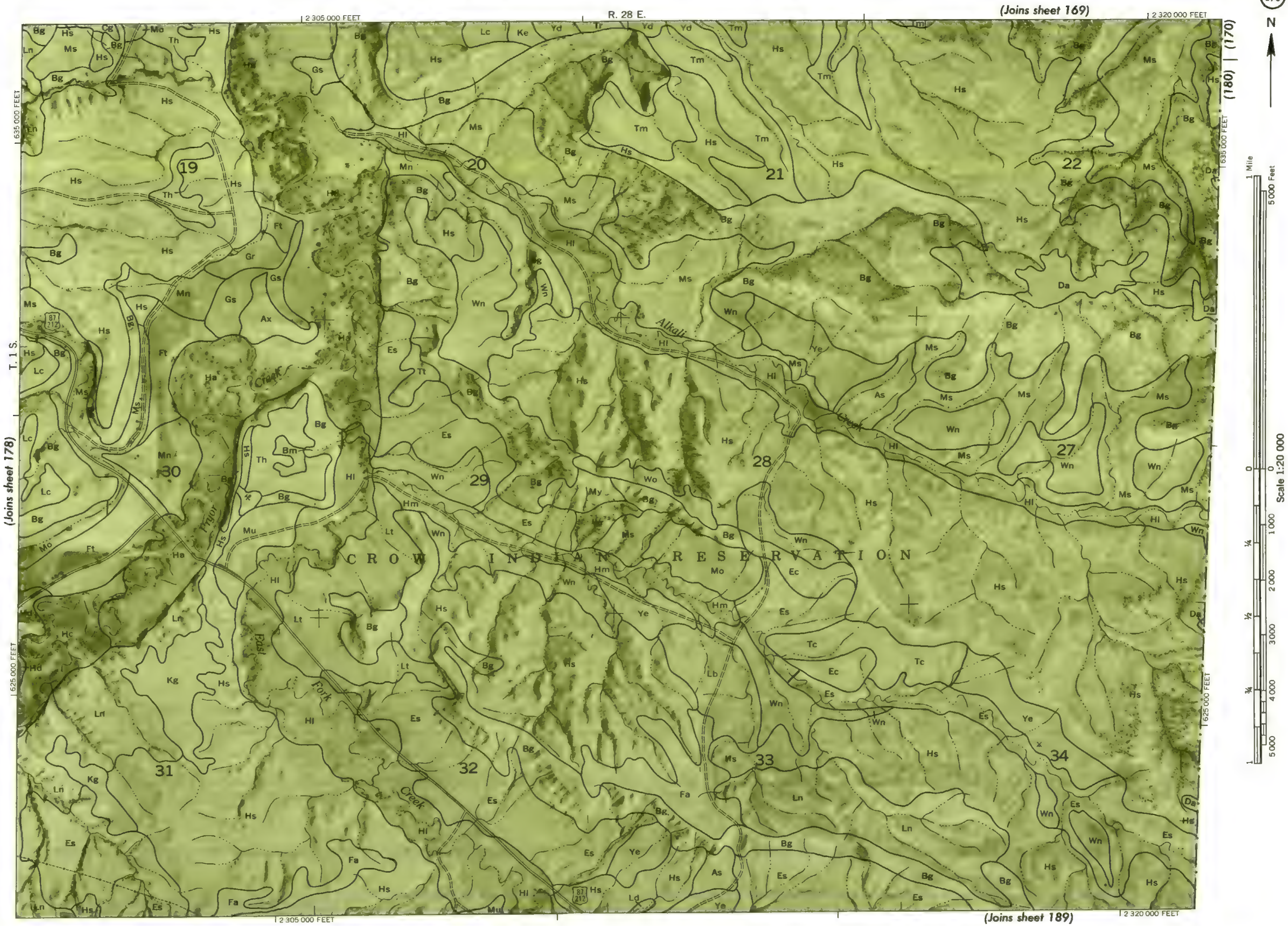


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 179

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 18

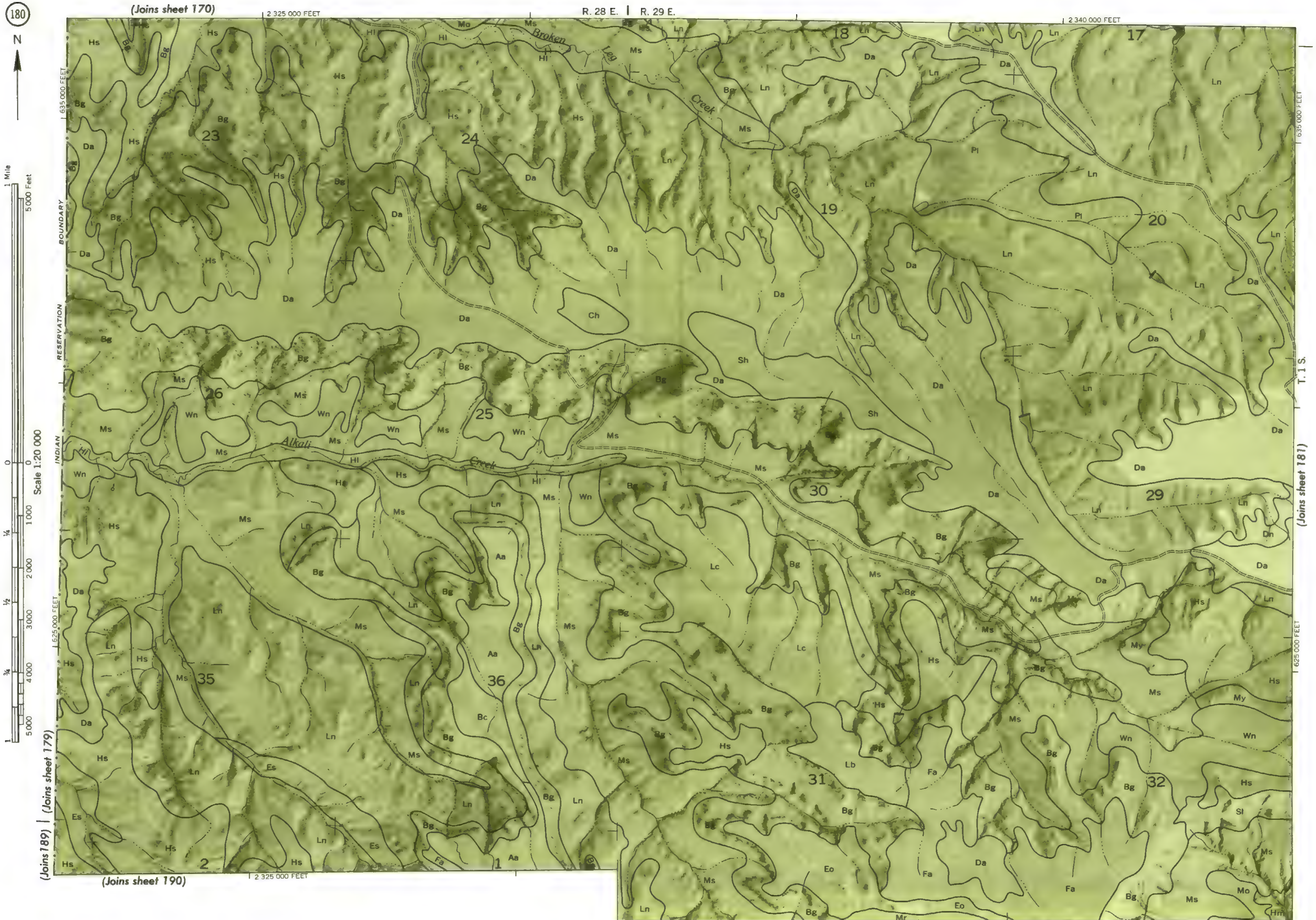
YELLOWSTONE COUNTY, MONTANA NO. 18

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

(Joins sheet 170)



(Joins sheet 181)

(Joins sheet 189) | (Joins sheet 179)

(Joins sheet 190)

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 180

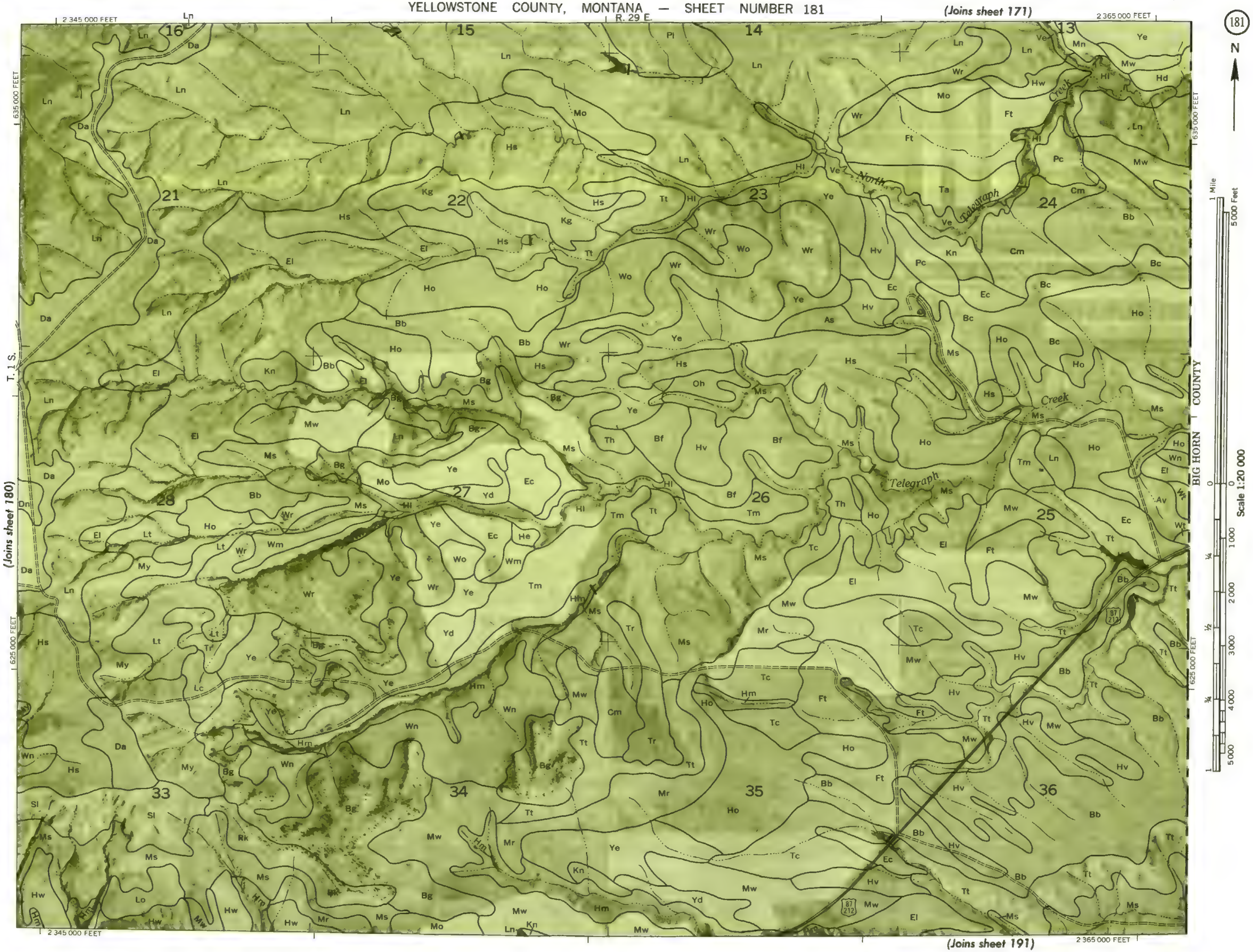
YELLOWSTONE COUNTY, MONTANA NO. 180

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 181



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 181

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 182

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 182

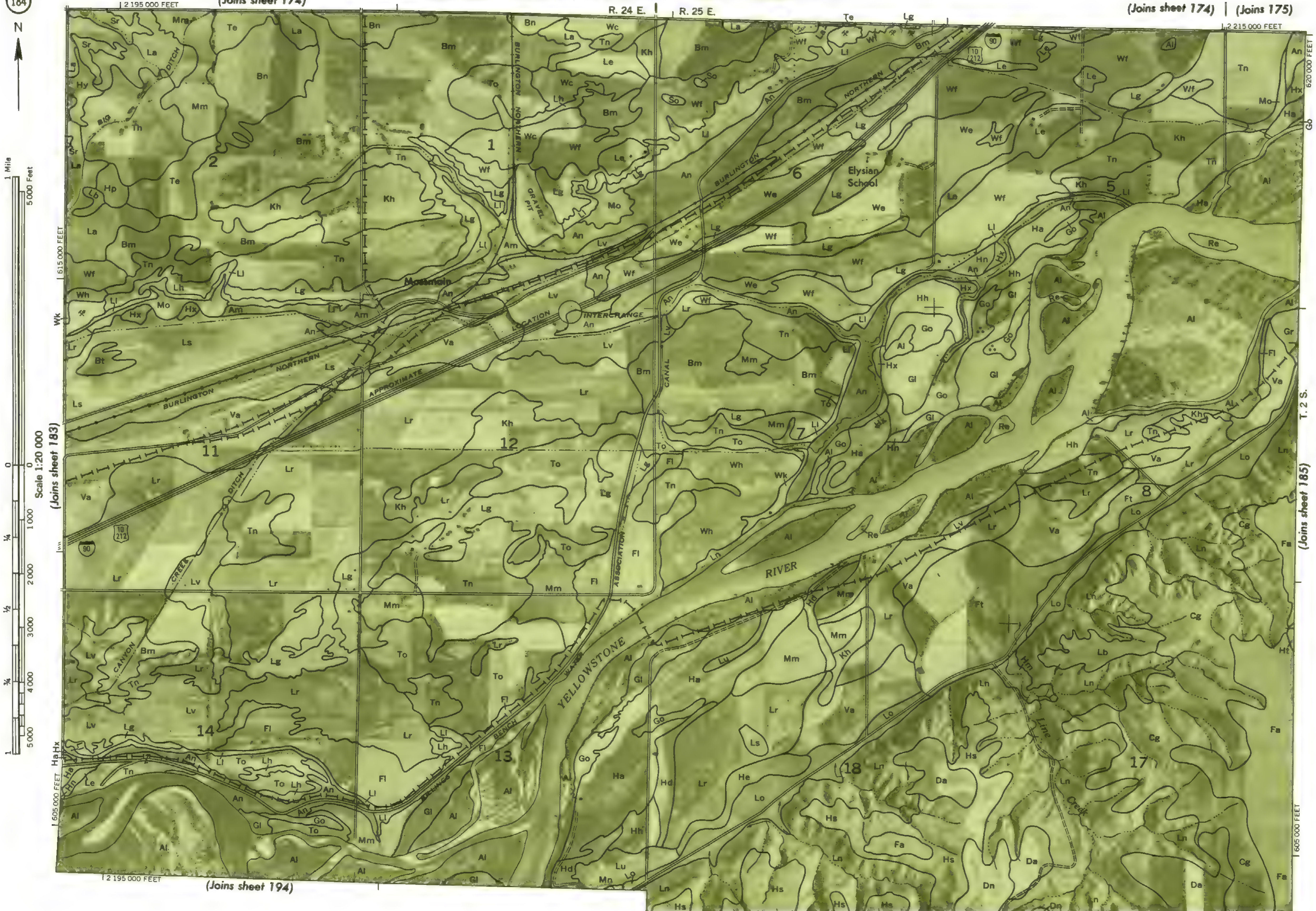
Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station
Land division corners are approximately positioned on this map.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 184



YELLOWSTONE COUNTY, MONTANA NO. 184

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

(Joins sheet 175) | (Joins 176)

185

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 185

186

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 186

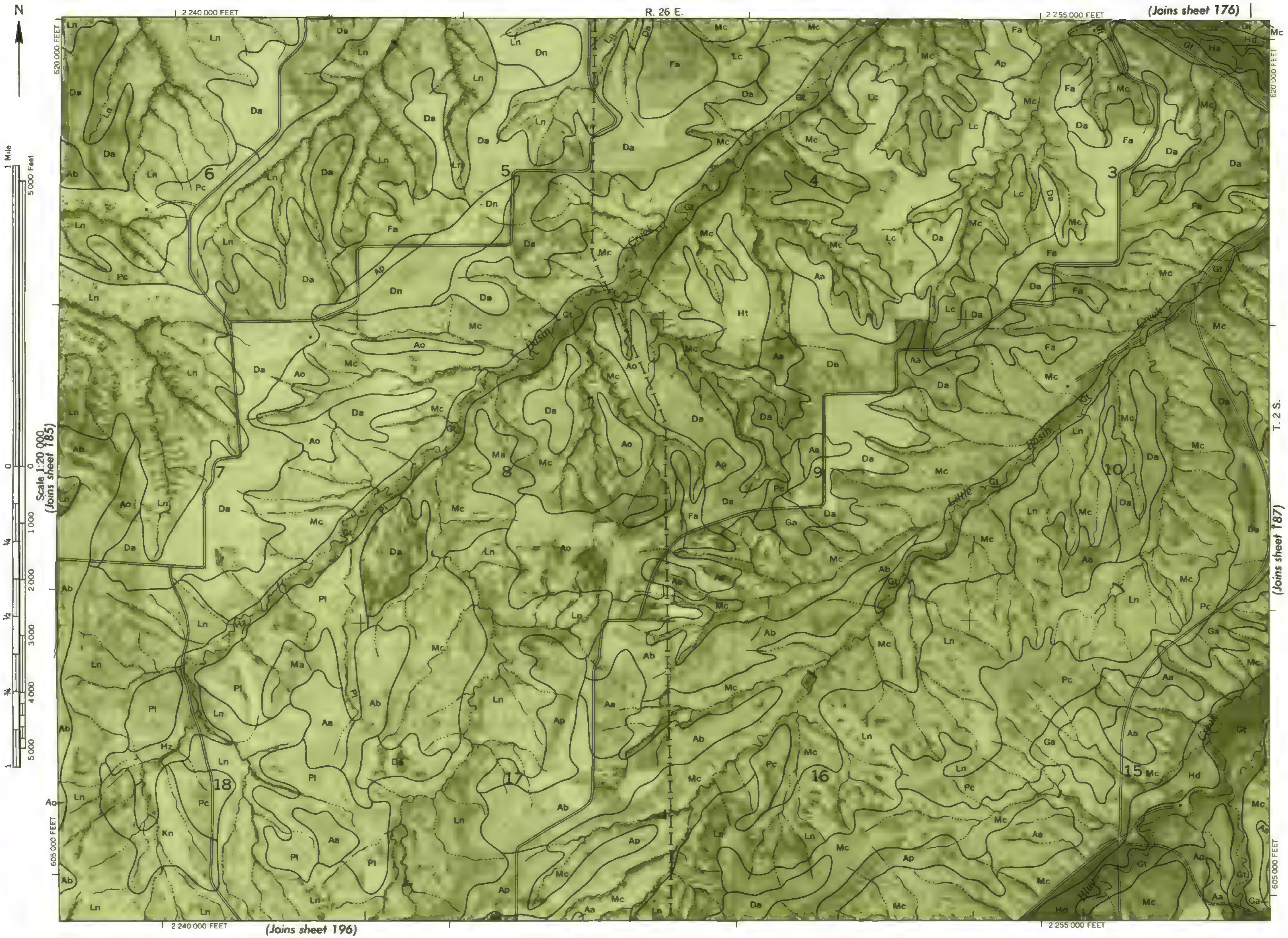


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 186

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 187

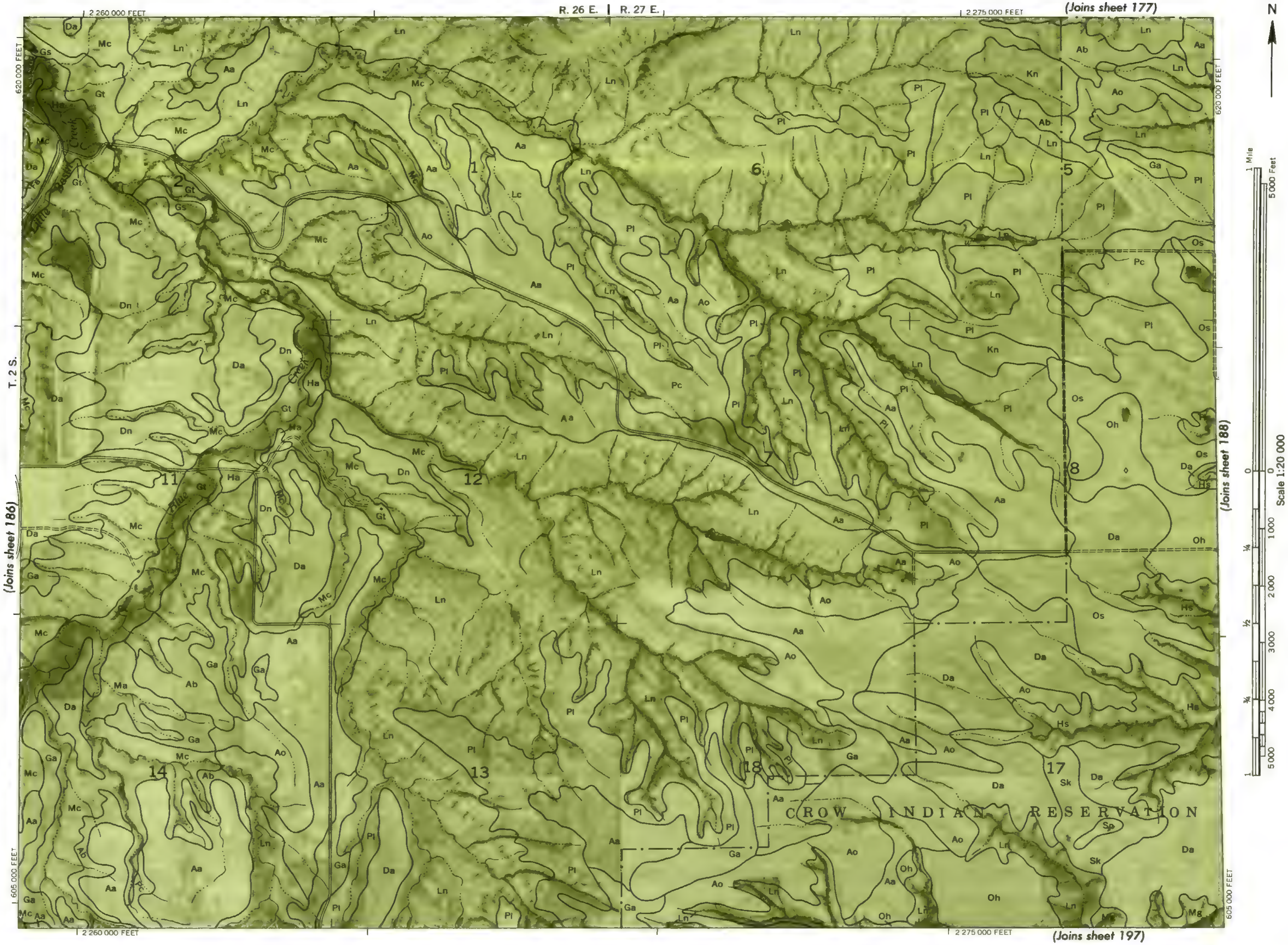


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 187

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 188

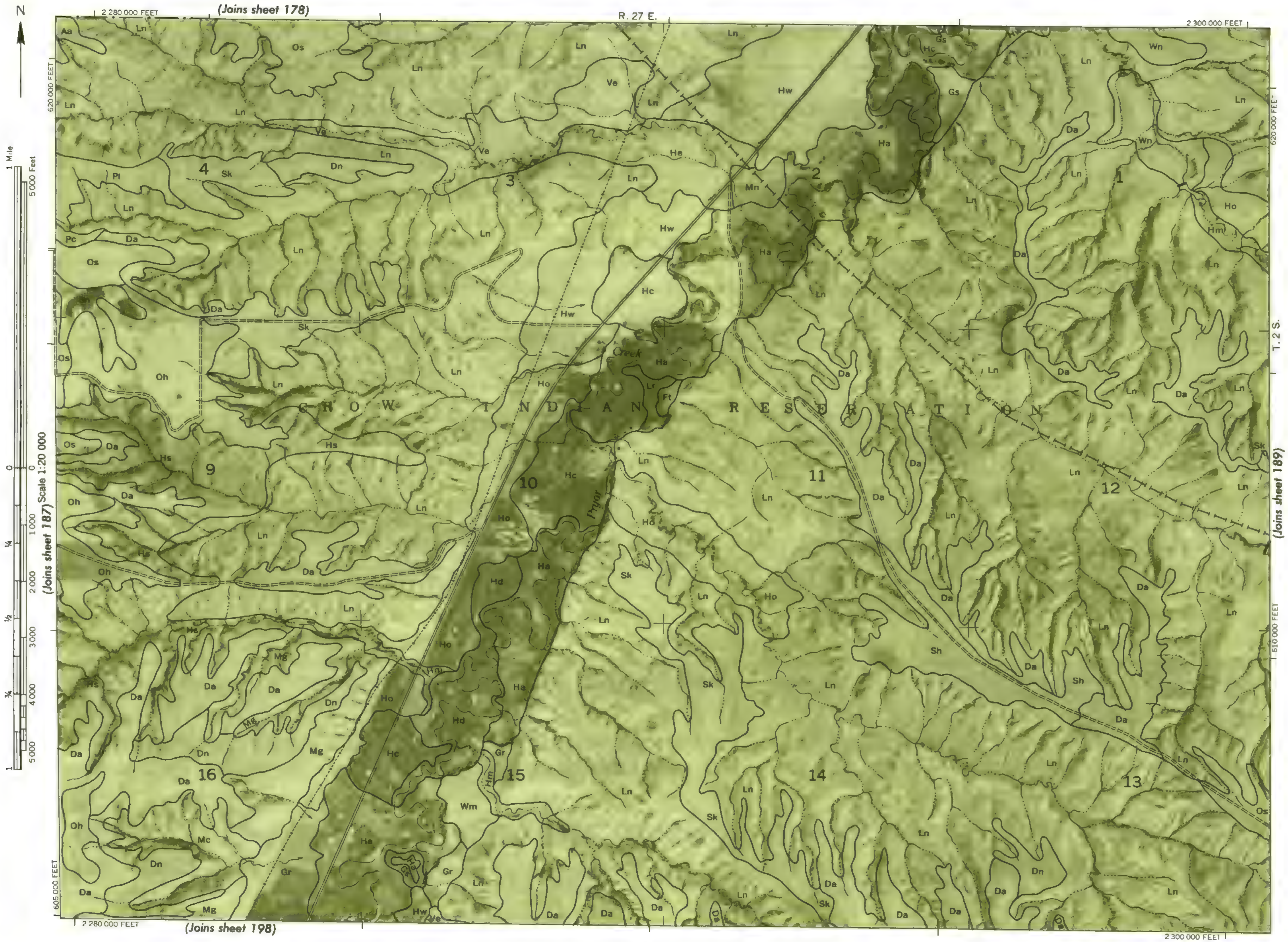


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 188

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

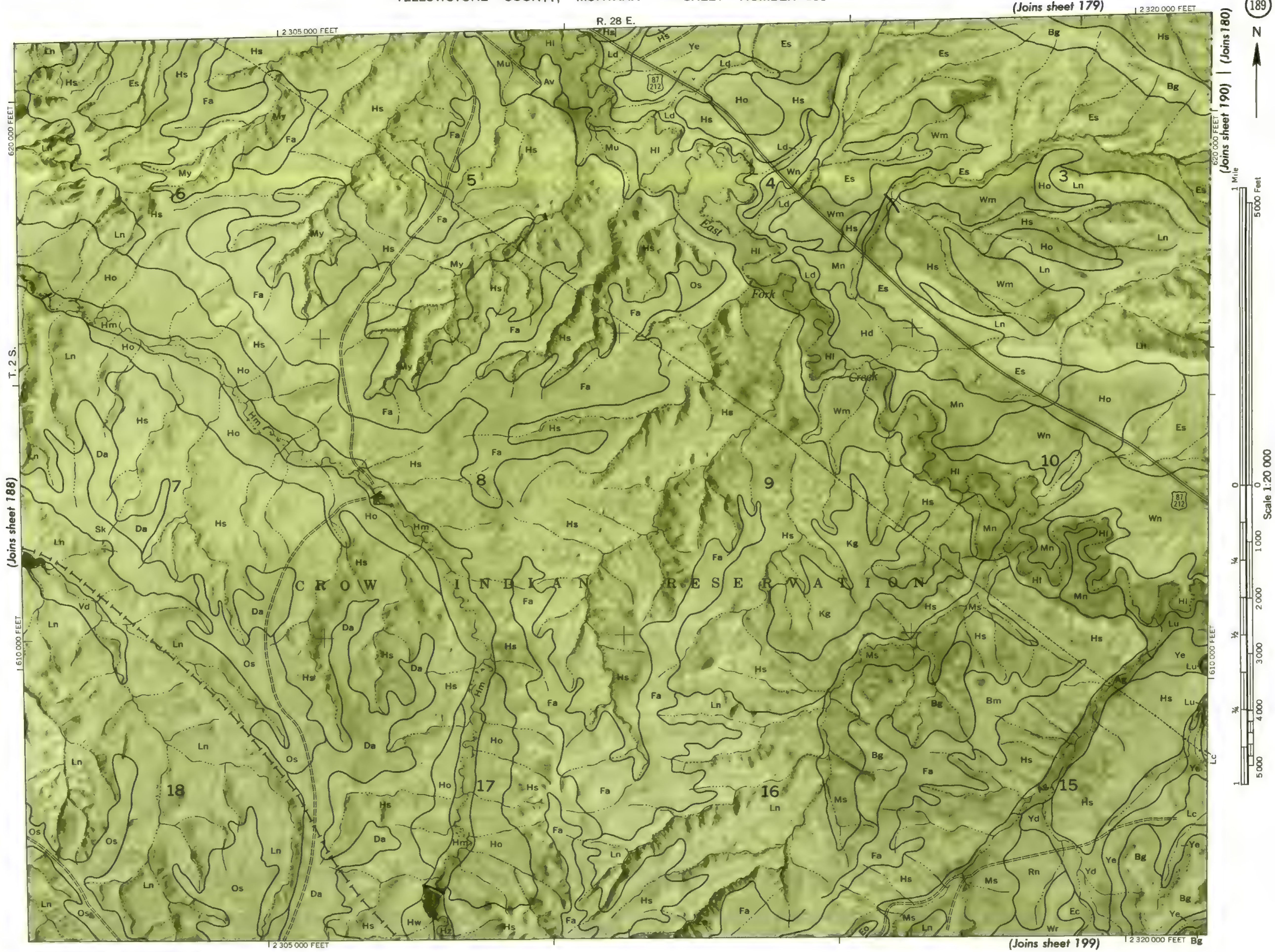
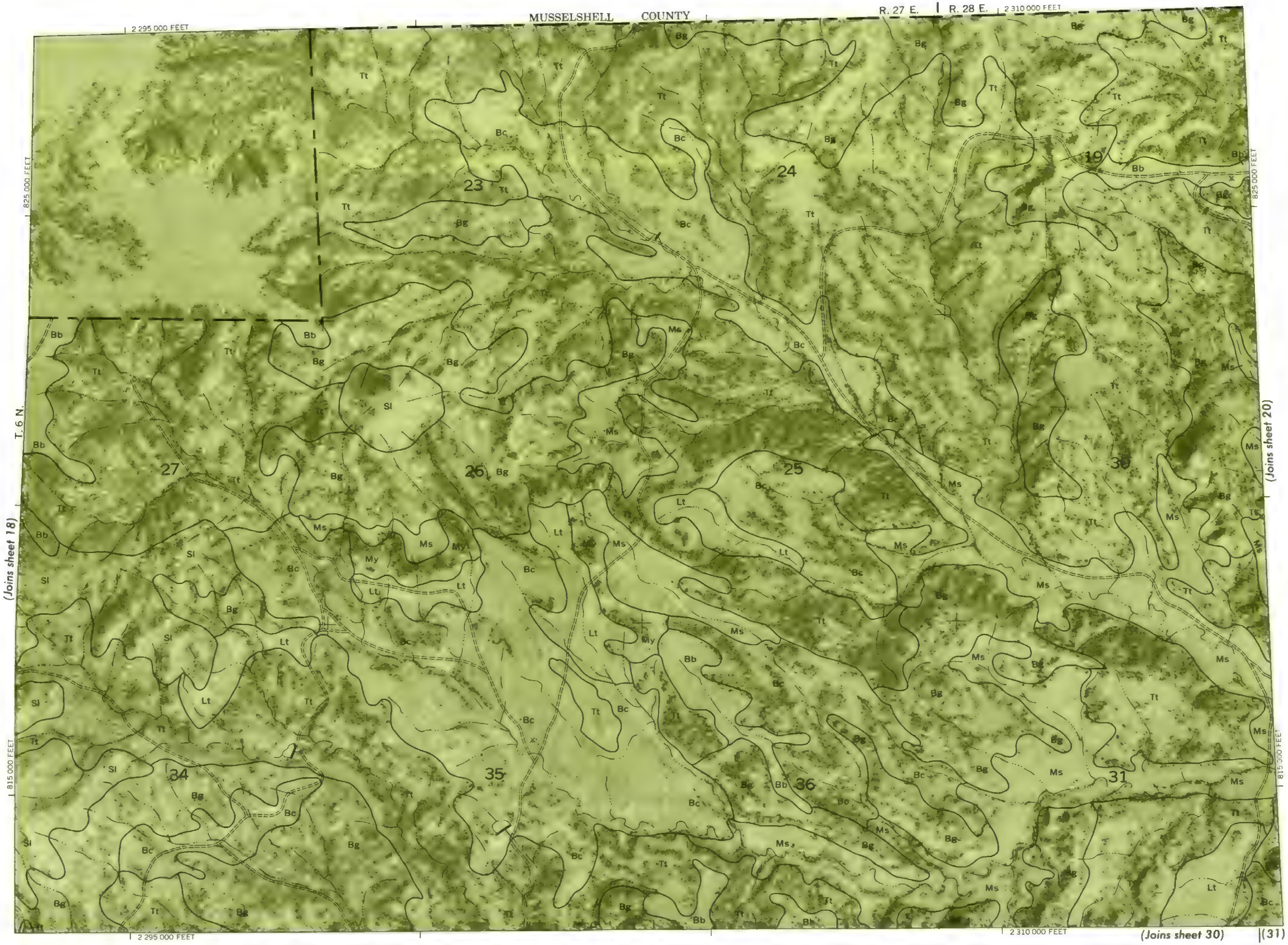


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.



N

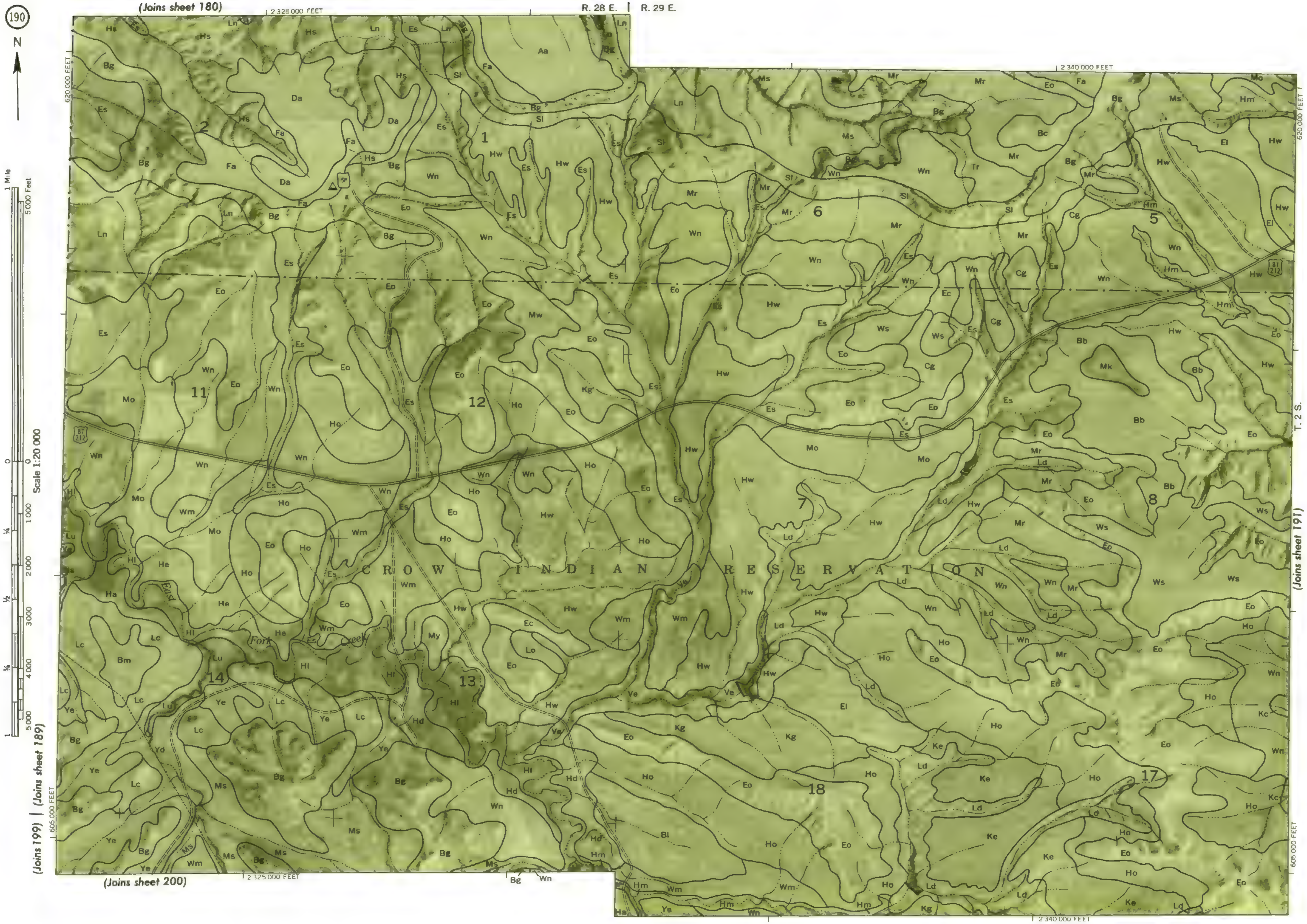
1 Mile
5000 Feet
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
Scale 1:20 000

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 19

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



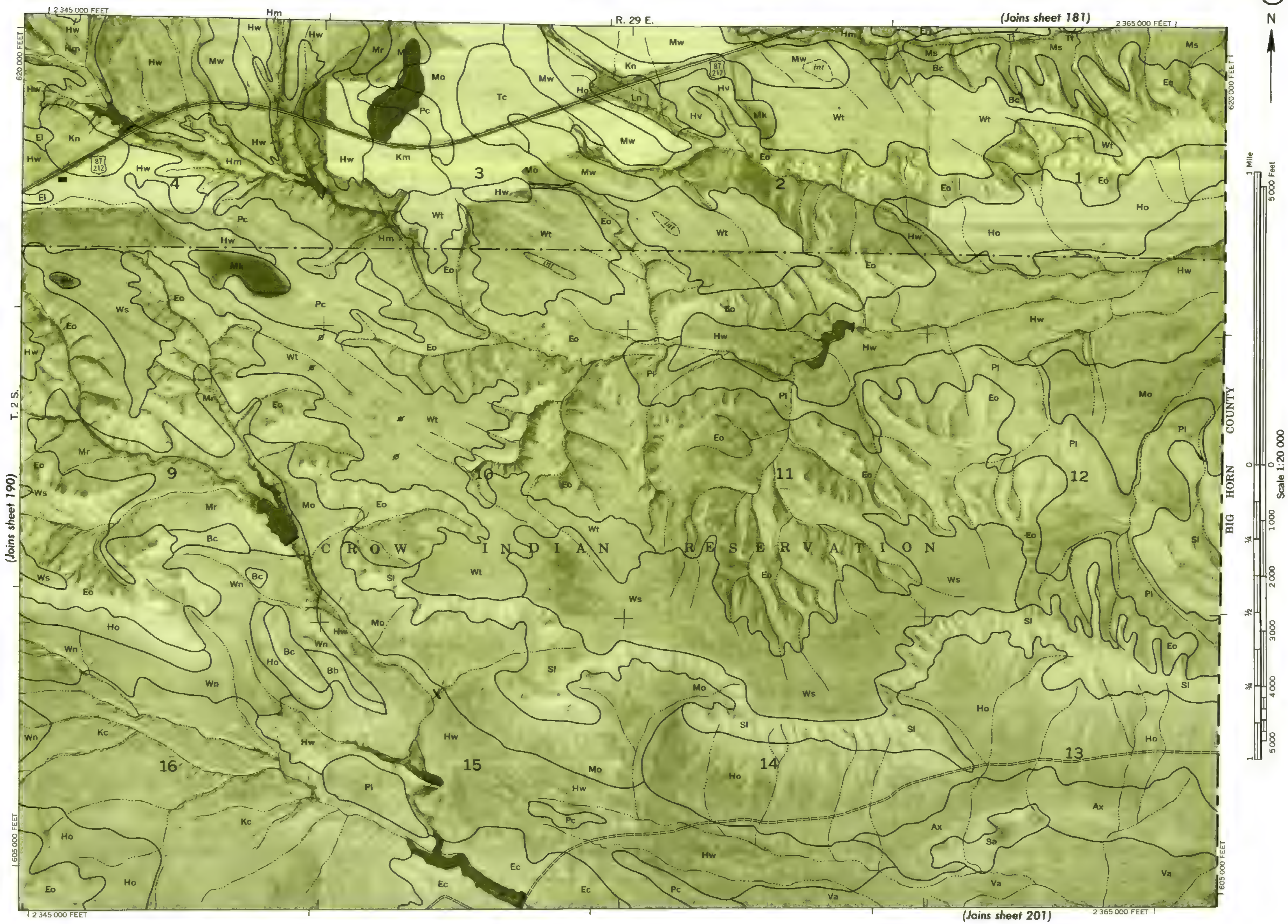
YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 190

YELLOWSTONE COUNTY, MONTANA NO. 190

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 191

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 192

(Joins sheet 182)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 192

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 193

193

(Joins sheet 183)

R. 24 E.

2 175 000 FEET

2 190 000 FEET

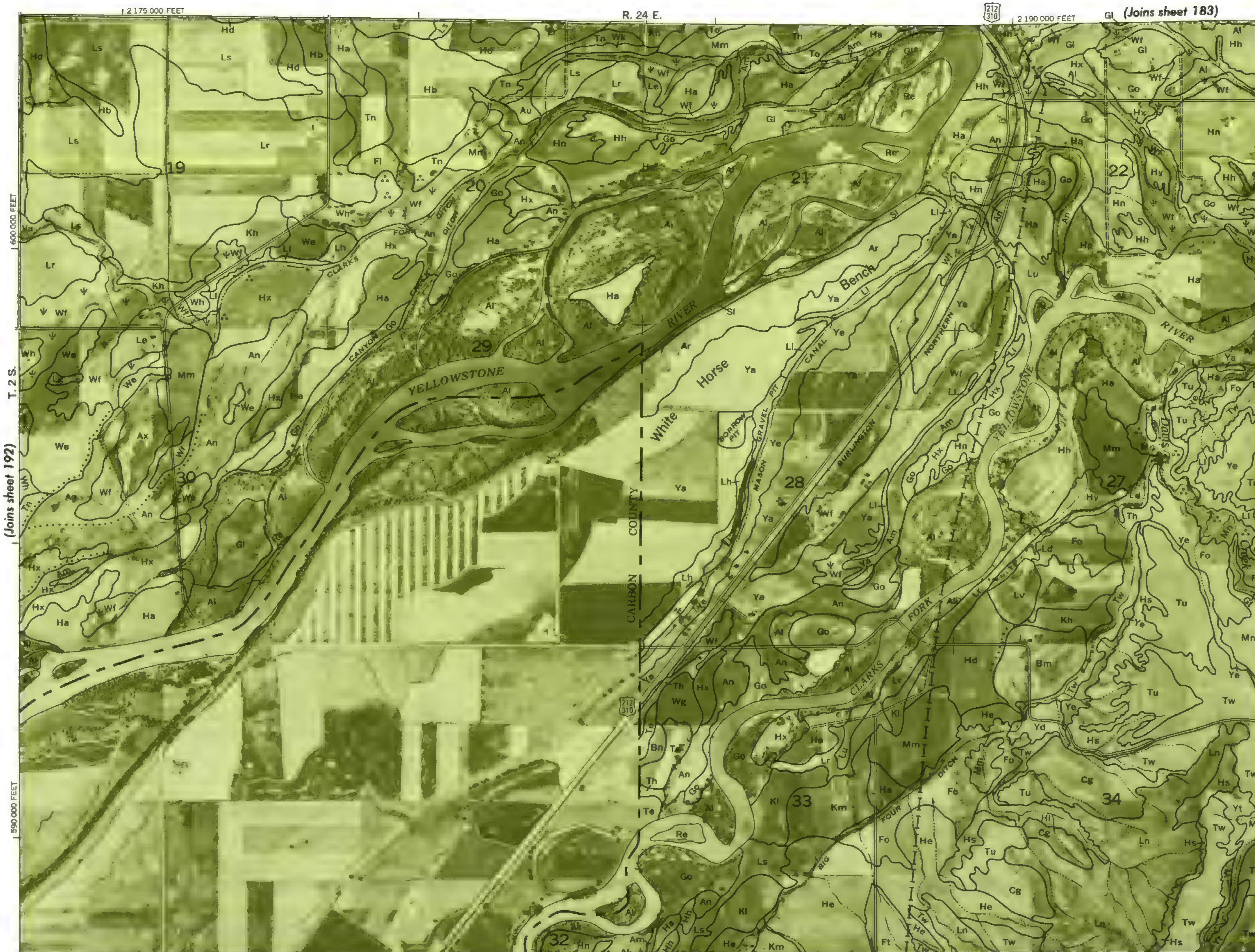
T. 2 S.

(Joins sheet 192)

(Joins sheet 194)

600 000 FEET

590 000 FEET



N

1 Mile

5000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

(Joins sheet 202)

2 175 000 FEET

2 190 000 FEET

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 193

194

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 194

N

1 Mile

5000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

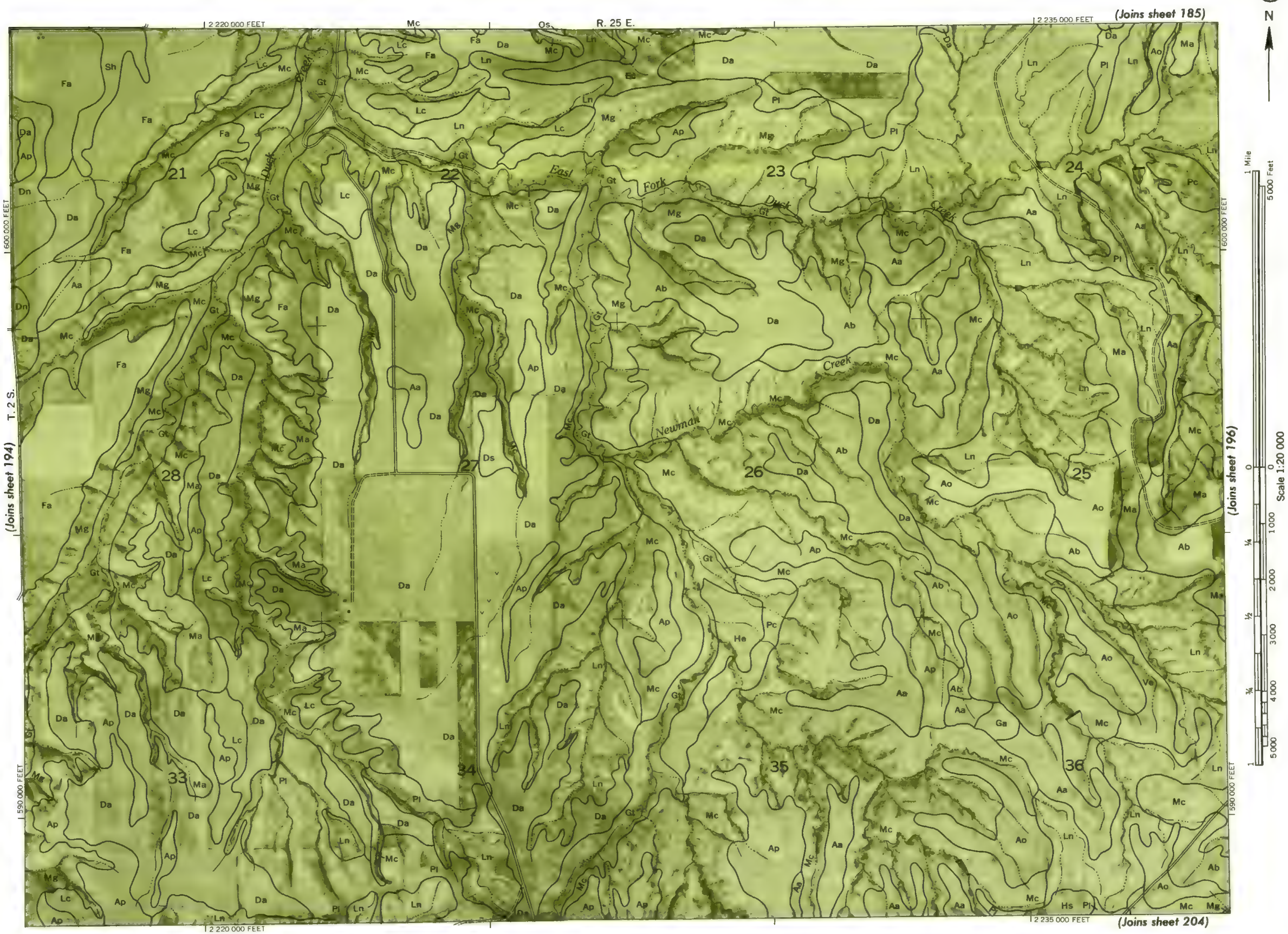
YELLOWSTONE COUNTY, MONTANA NO. 194

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 195



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 195

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

196

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 196

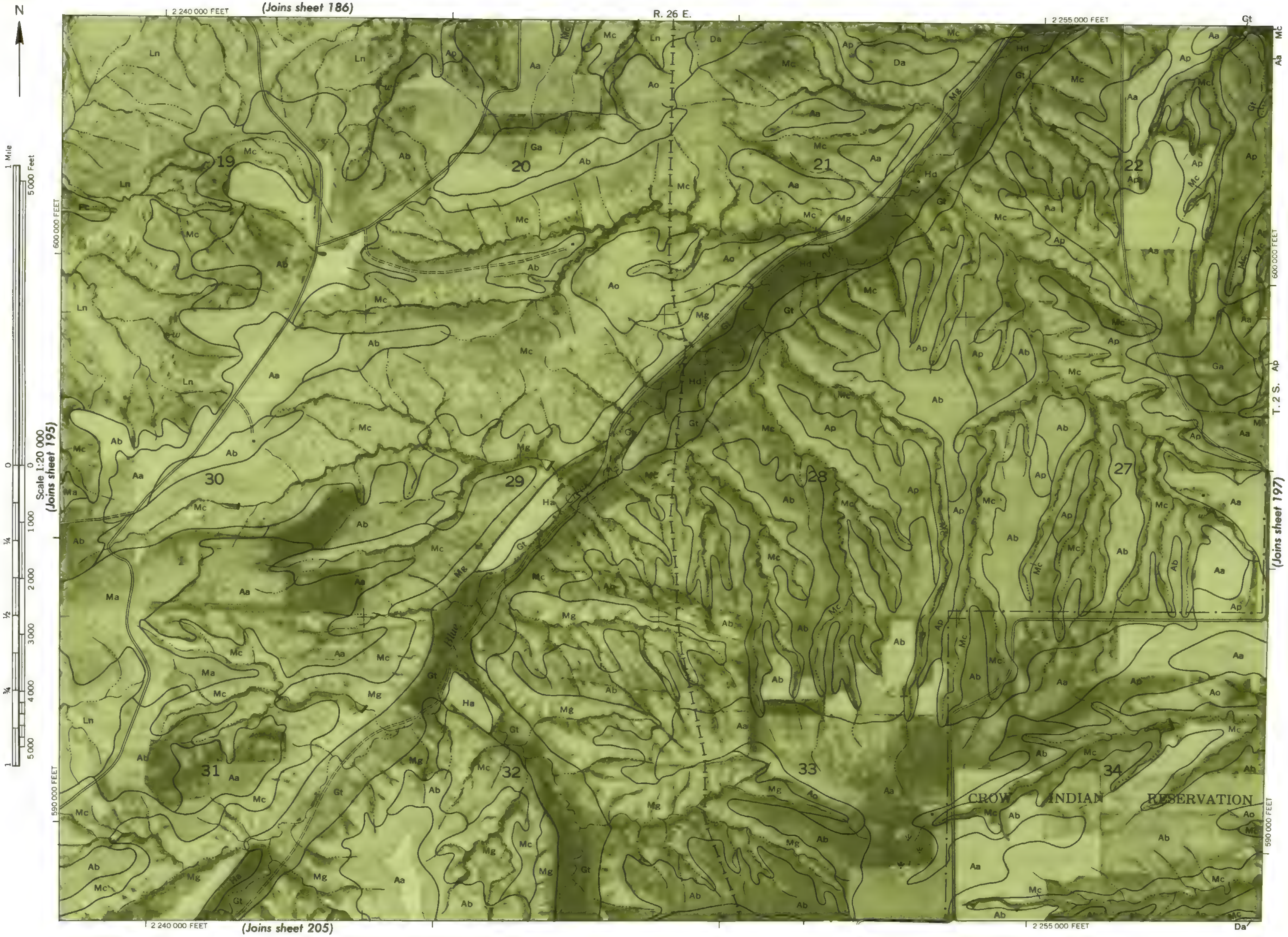


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 196

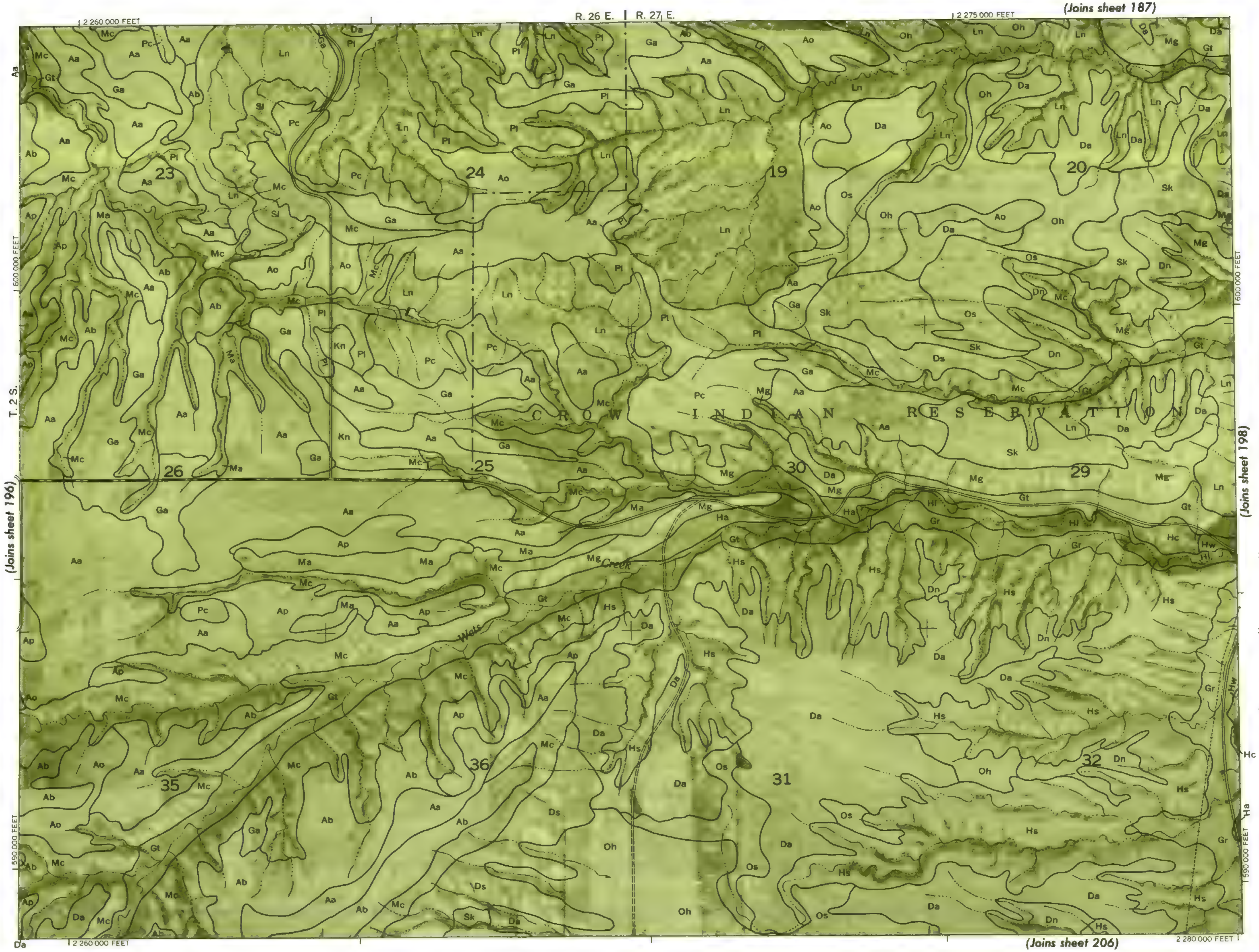
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 197



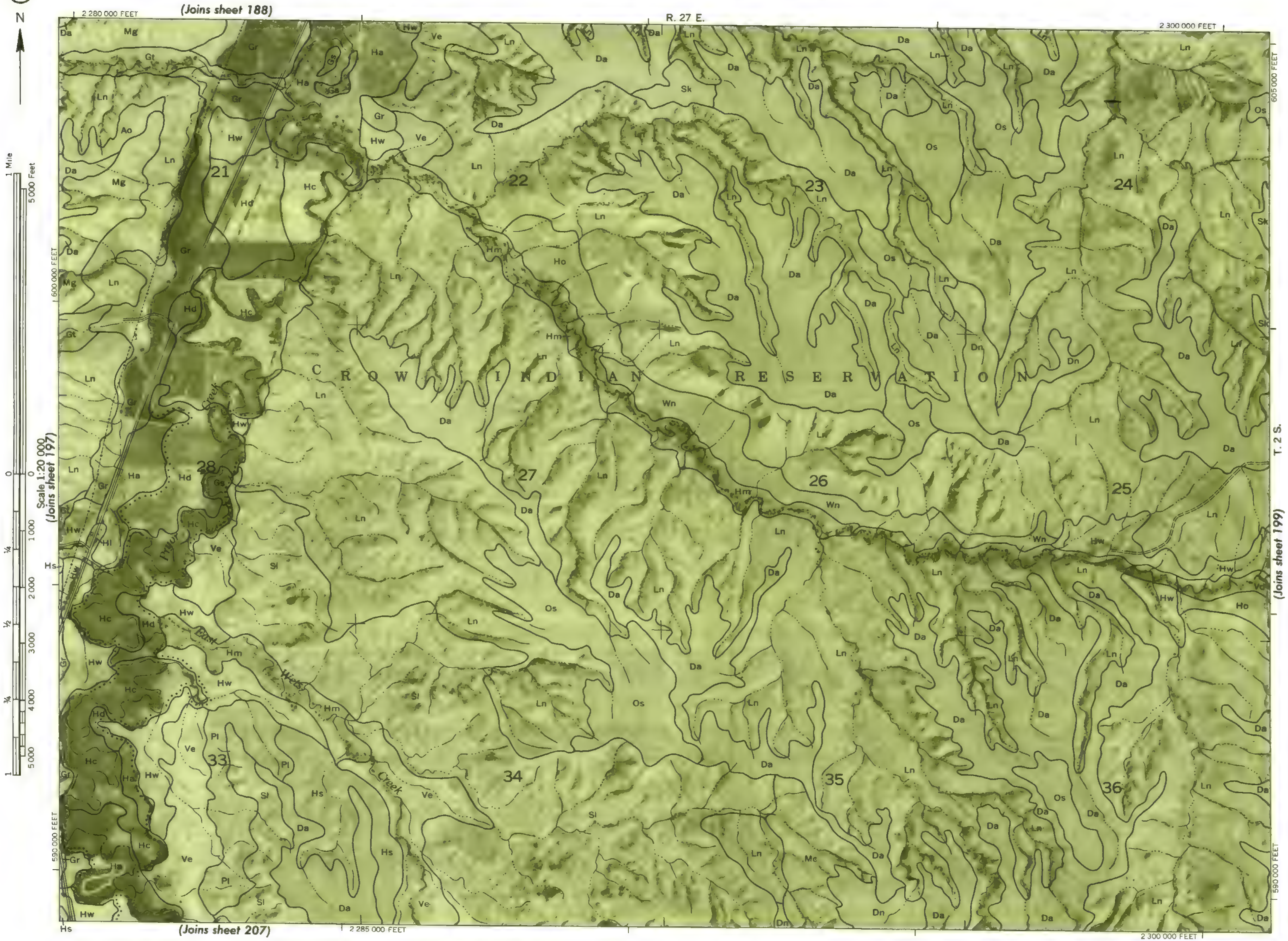
N

1 Mile
5000 Feet
Scale 1:20 000

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

198

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 198



YELLOWSTONE COUNTY, MONTANA NO. 198

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 199

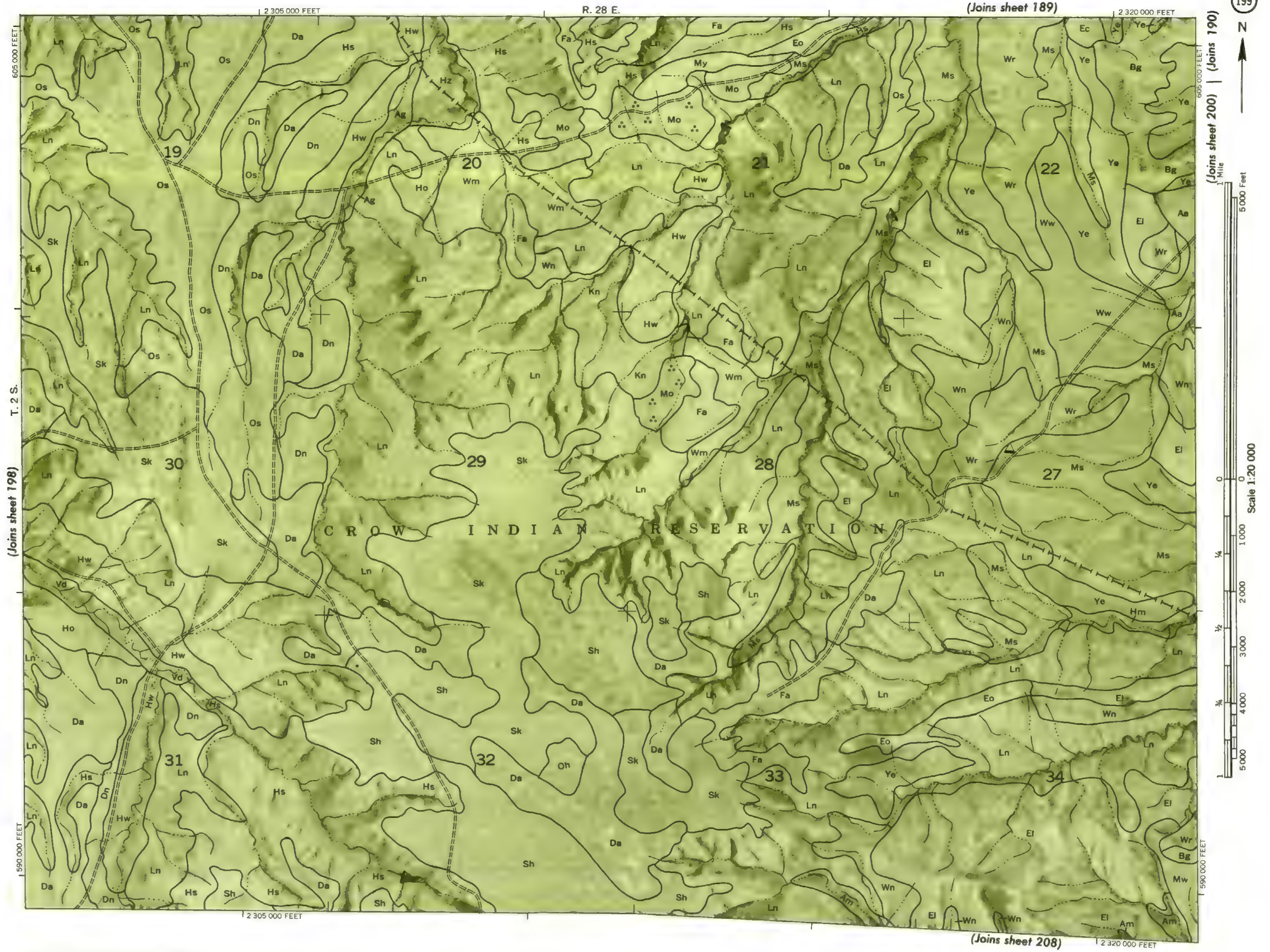
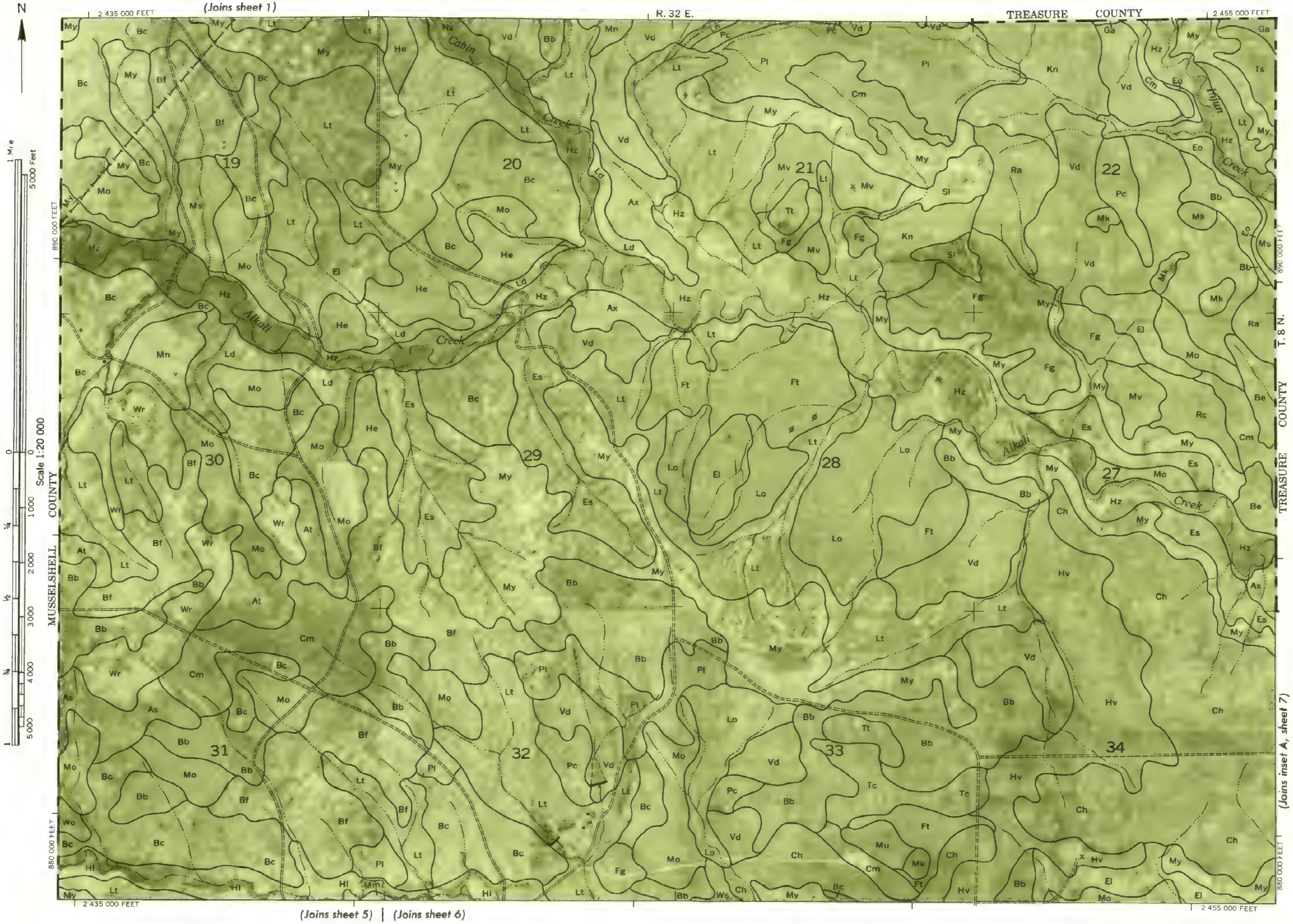


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

2

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 2

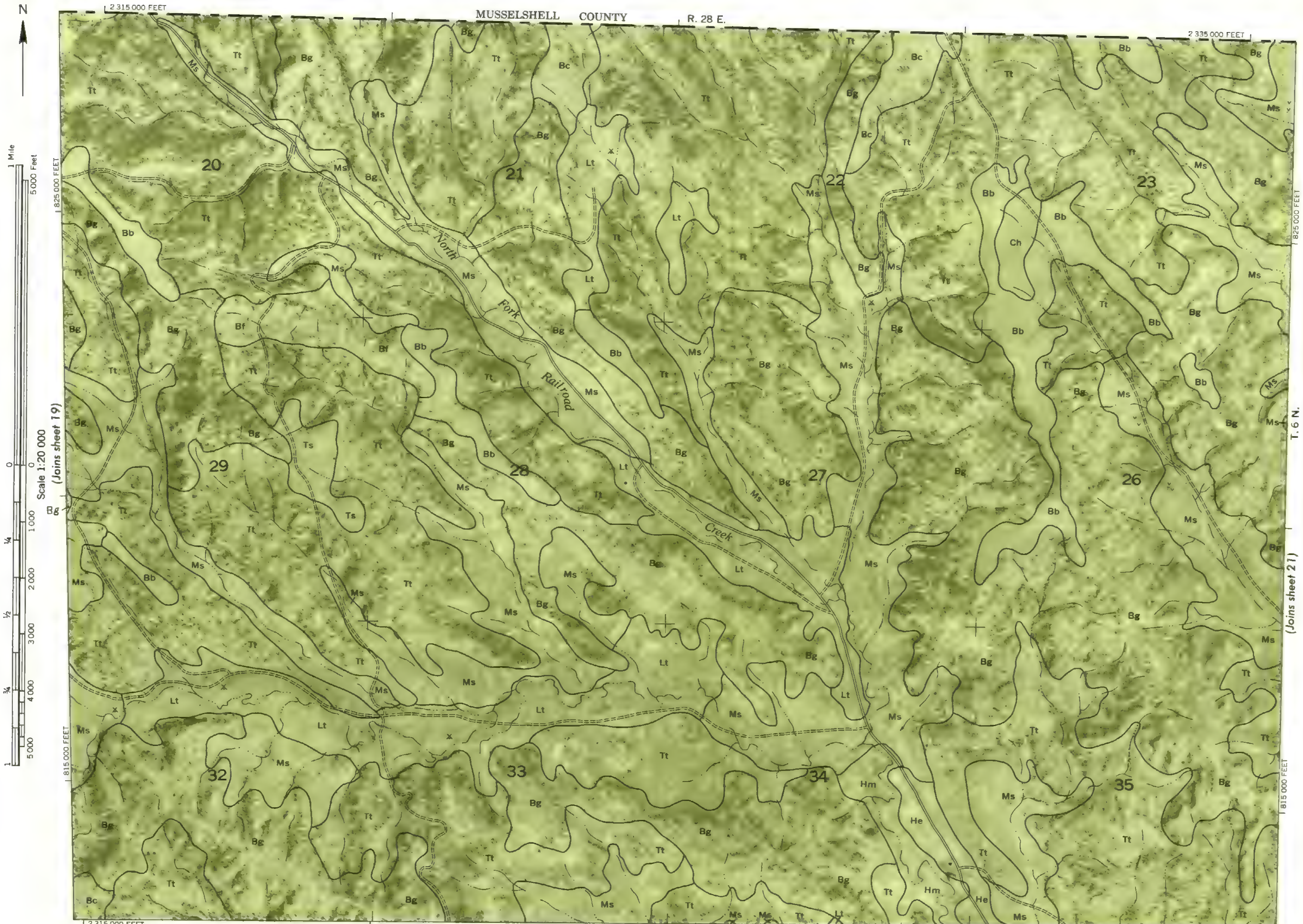


YELLOWSTONE COUNTY, MONTANA NO. 2

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum



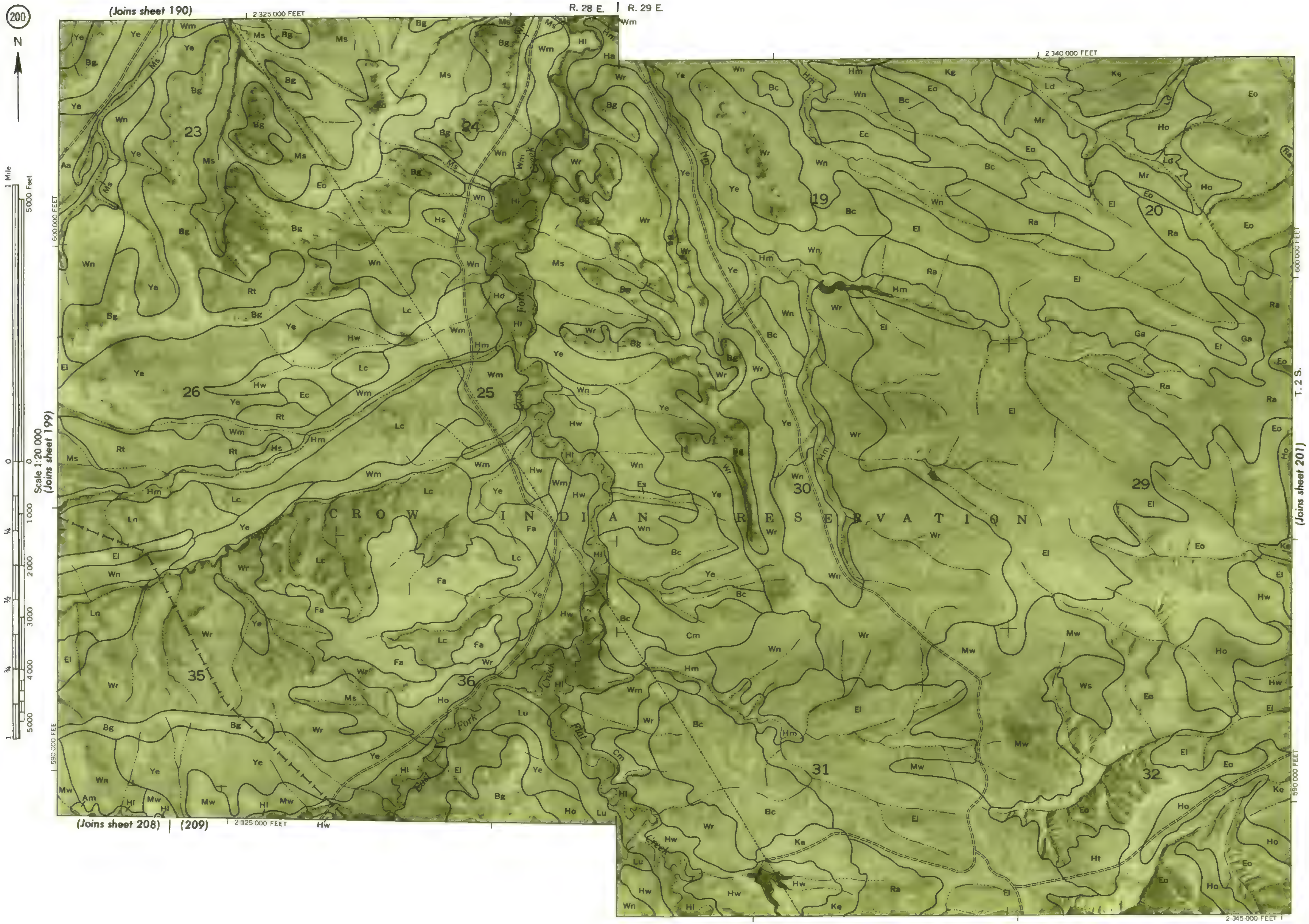
(Joins sheet 31) | (32)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 20

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station



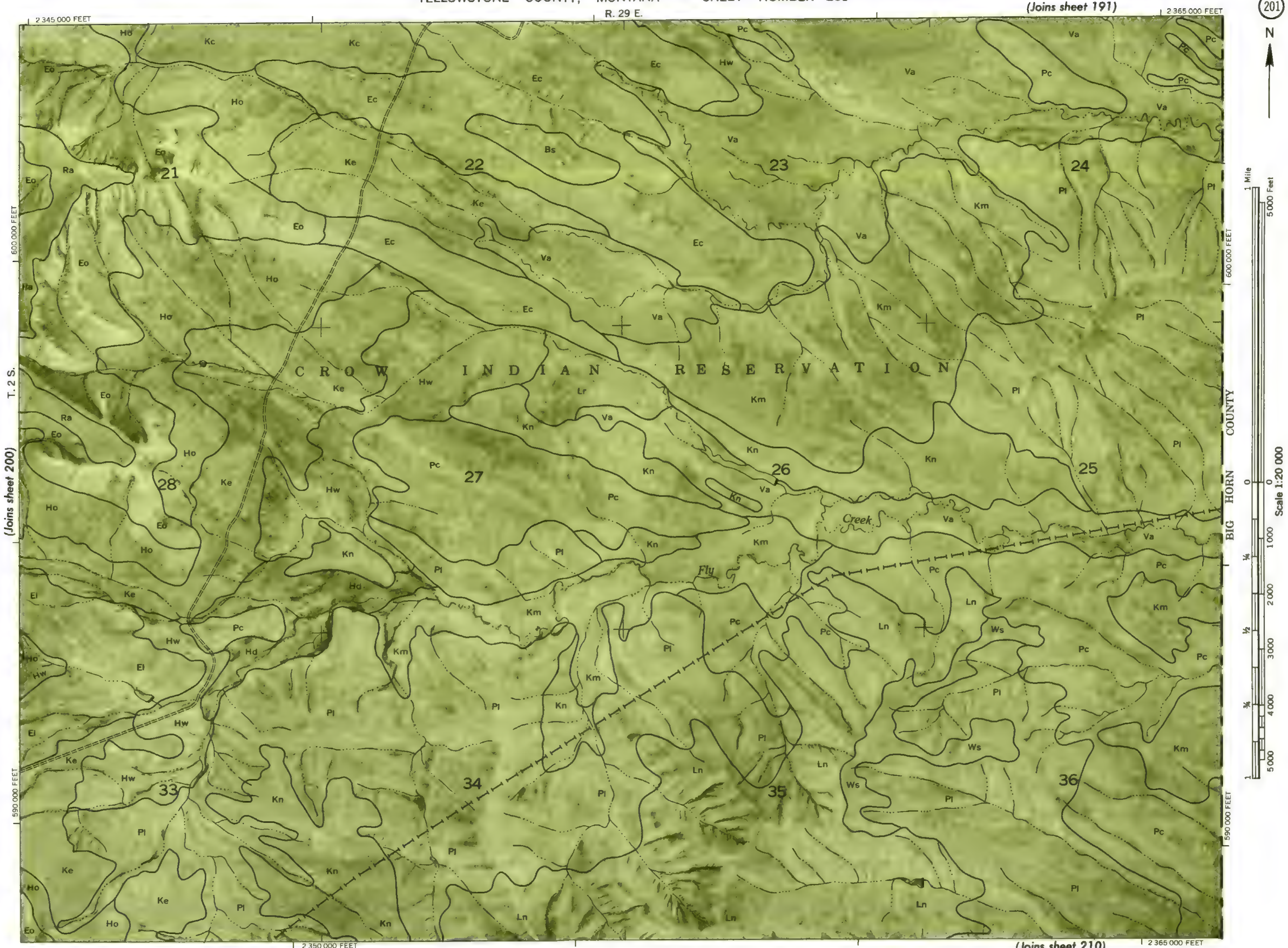
YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 200

YELLOWSTONE COUNTY, MONTANA NO. 200

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 201

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 202

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

203

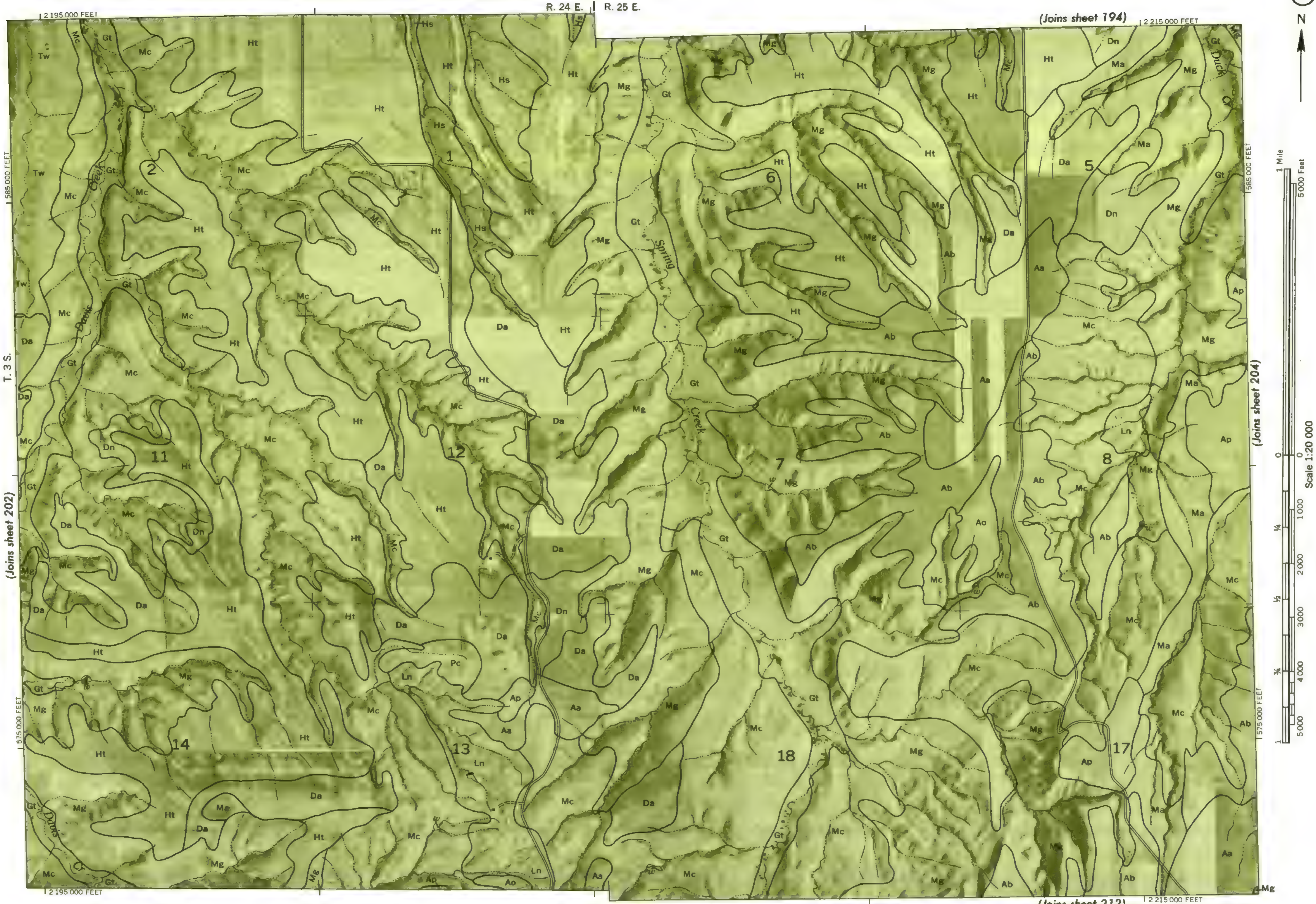


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 203

YELLOWSTONE COUNTY, MONTANA NO. 204

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA NO. 205

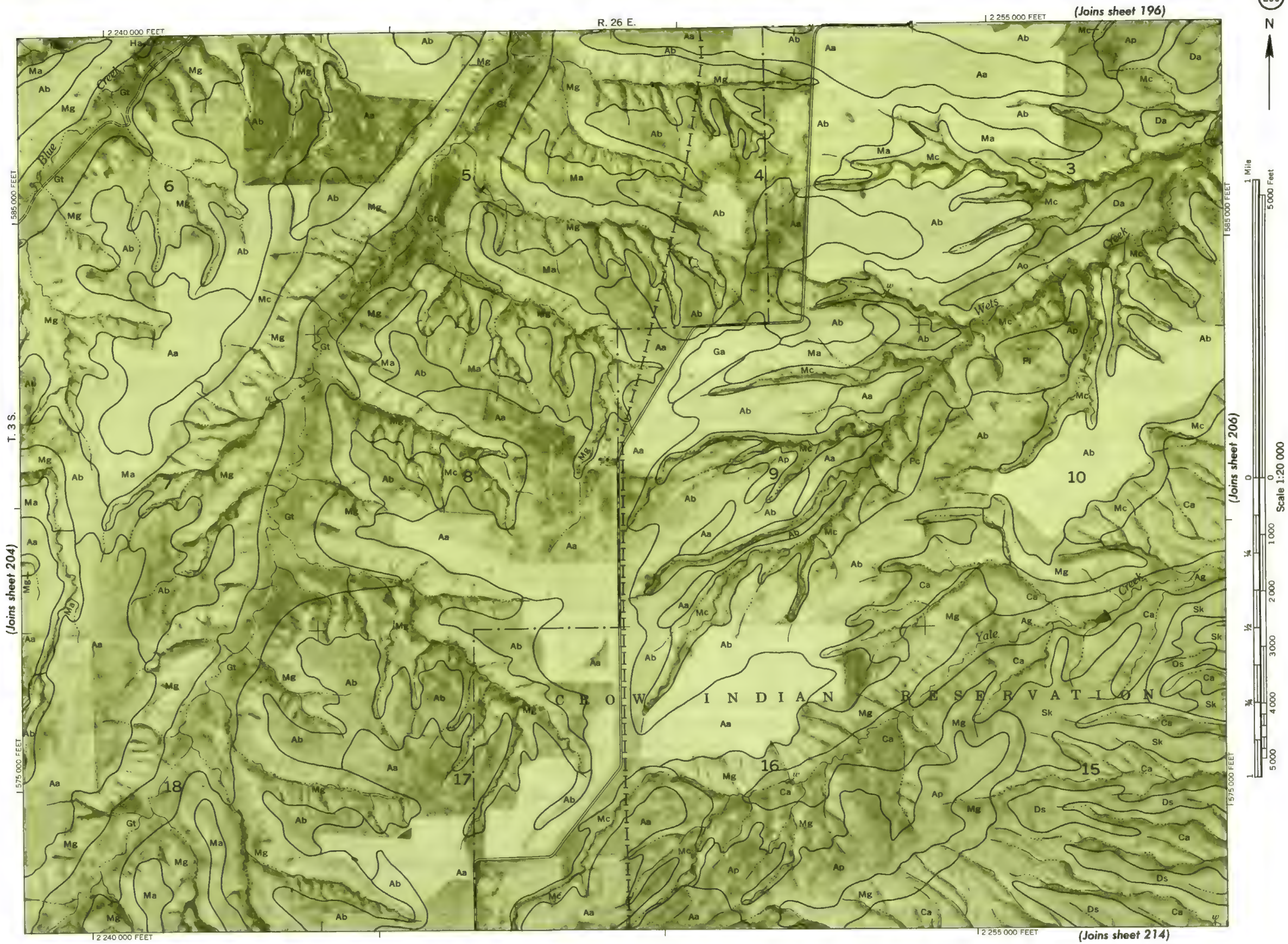


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 206

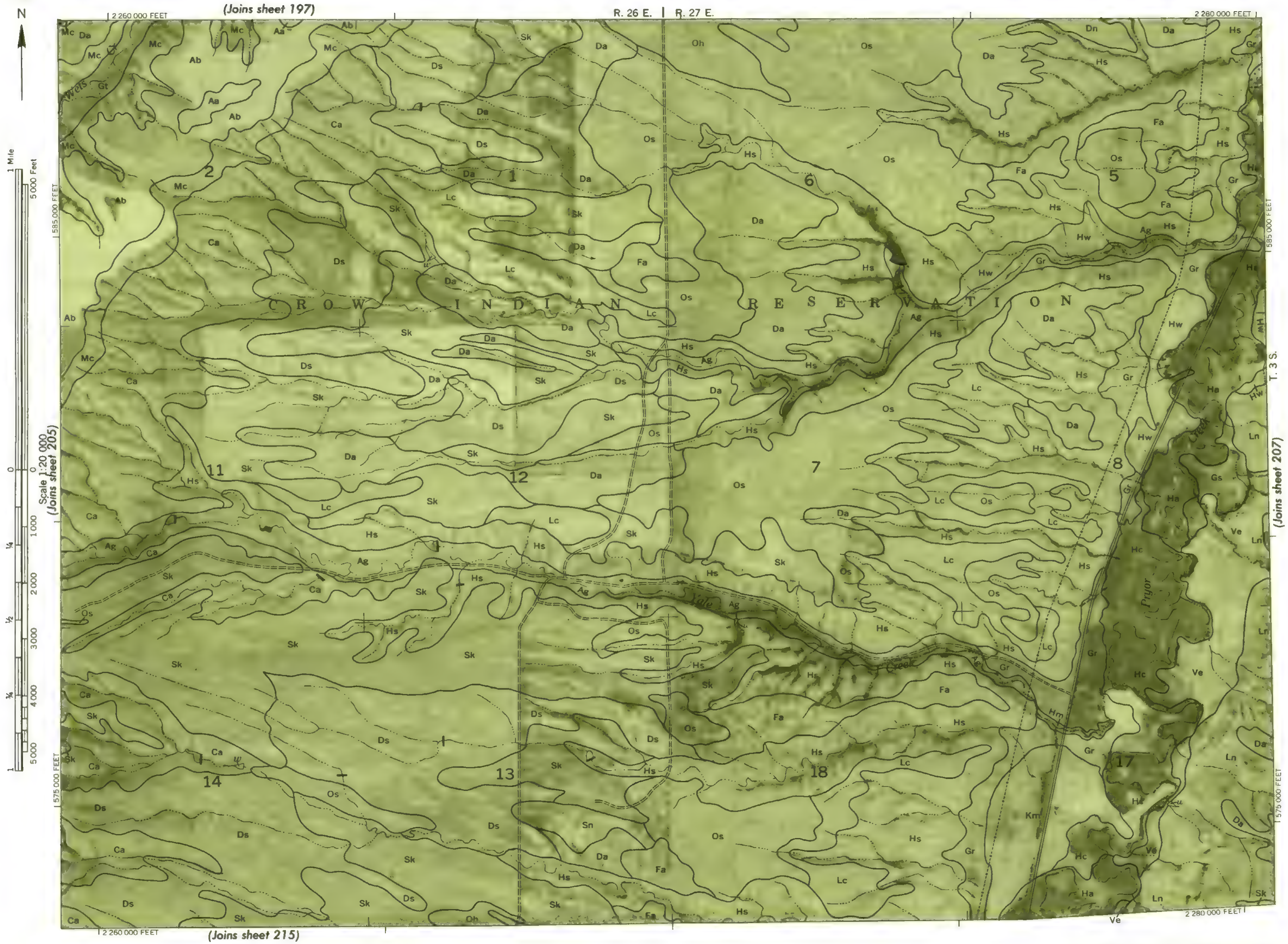
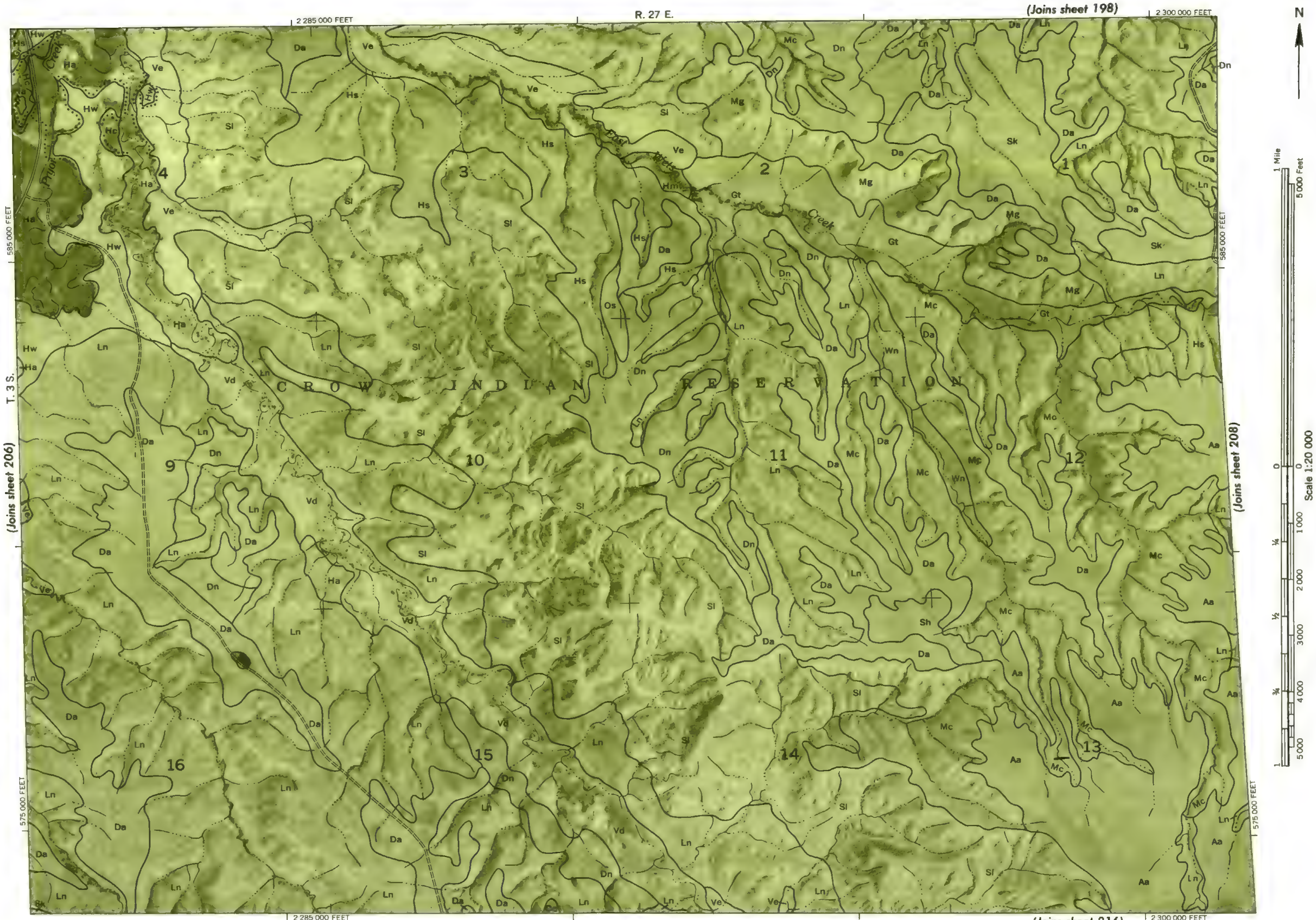


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 206

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 207

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 208

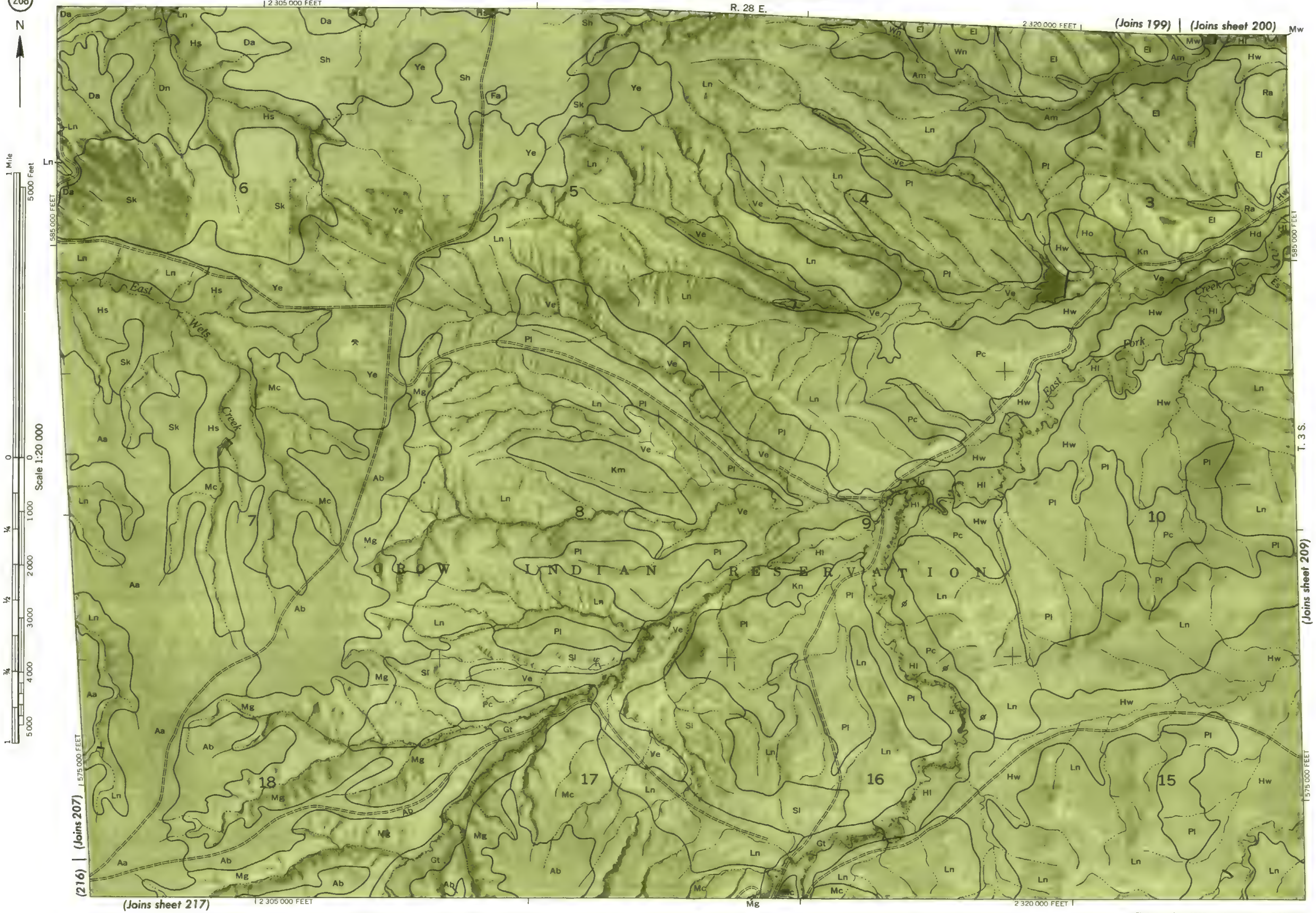


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 208

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 209

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 209

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

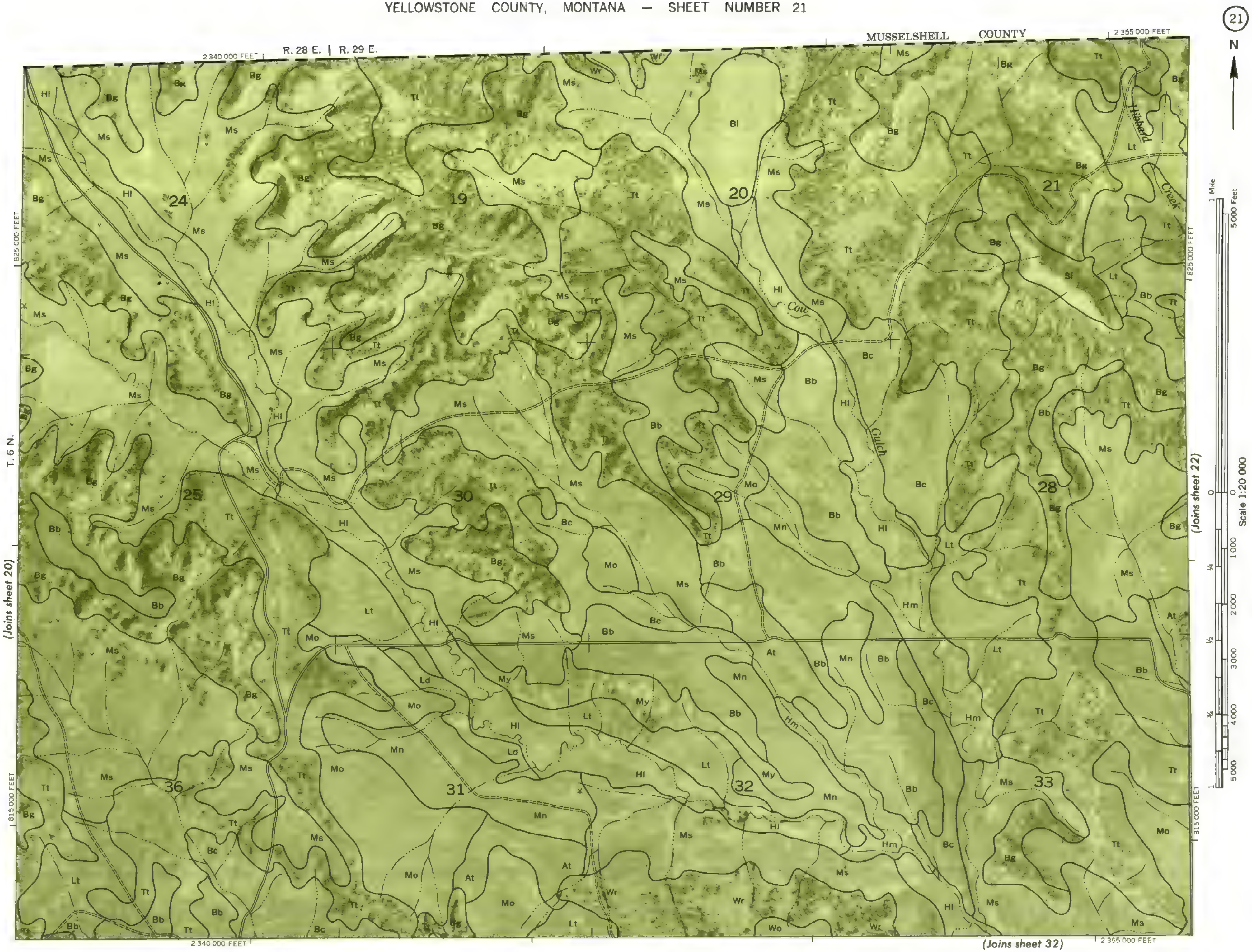
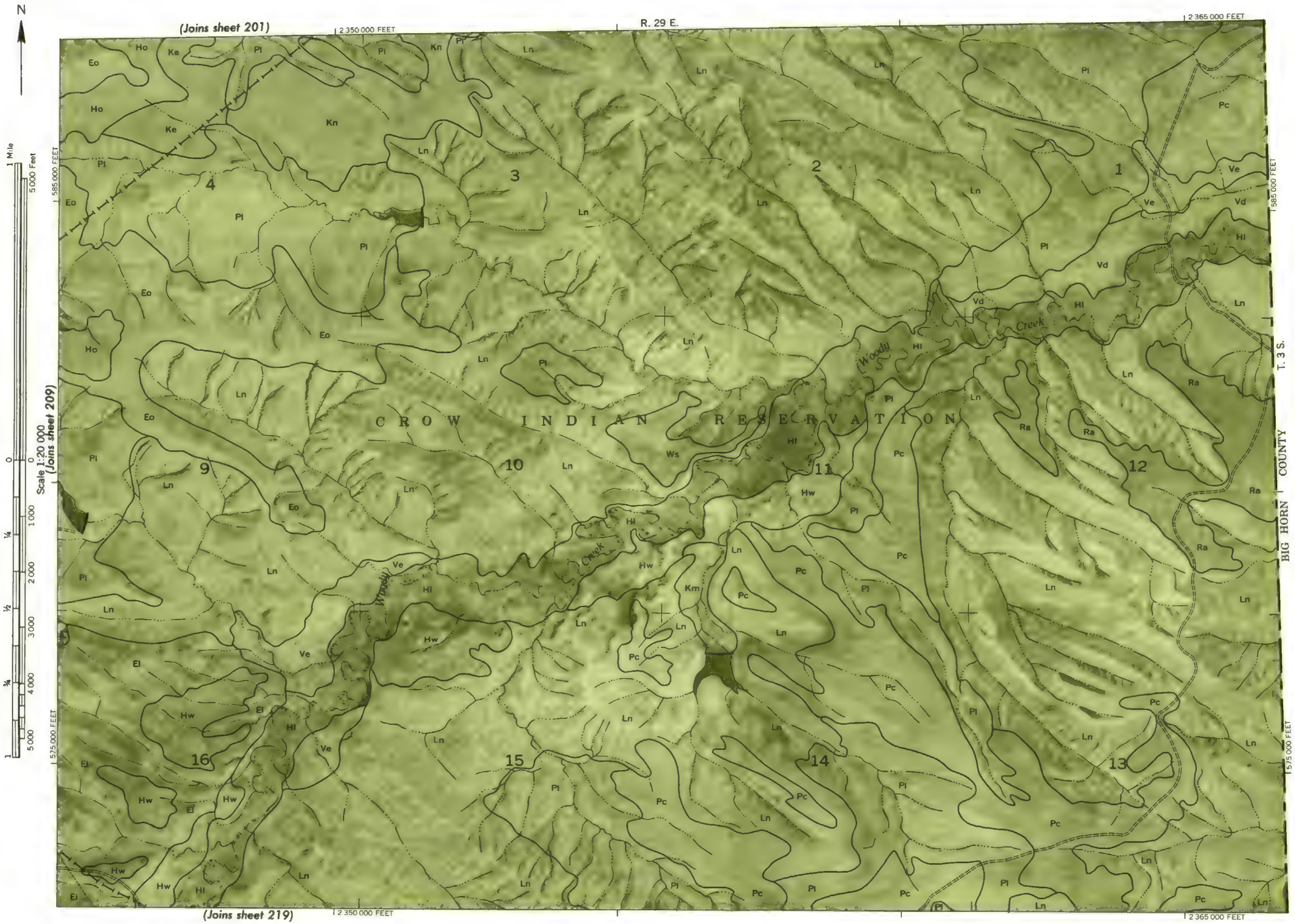


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 21

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 210

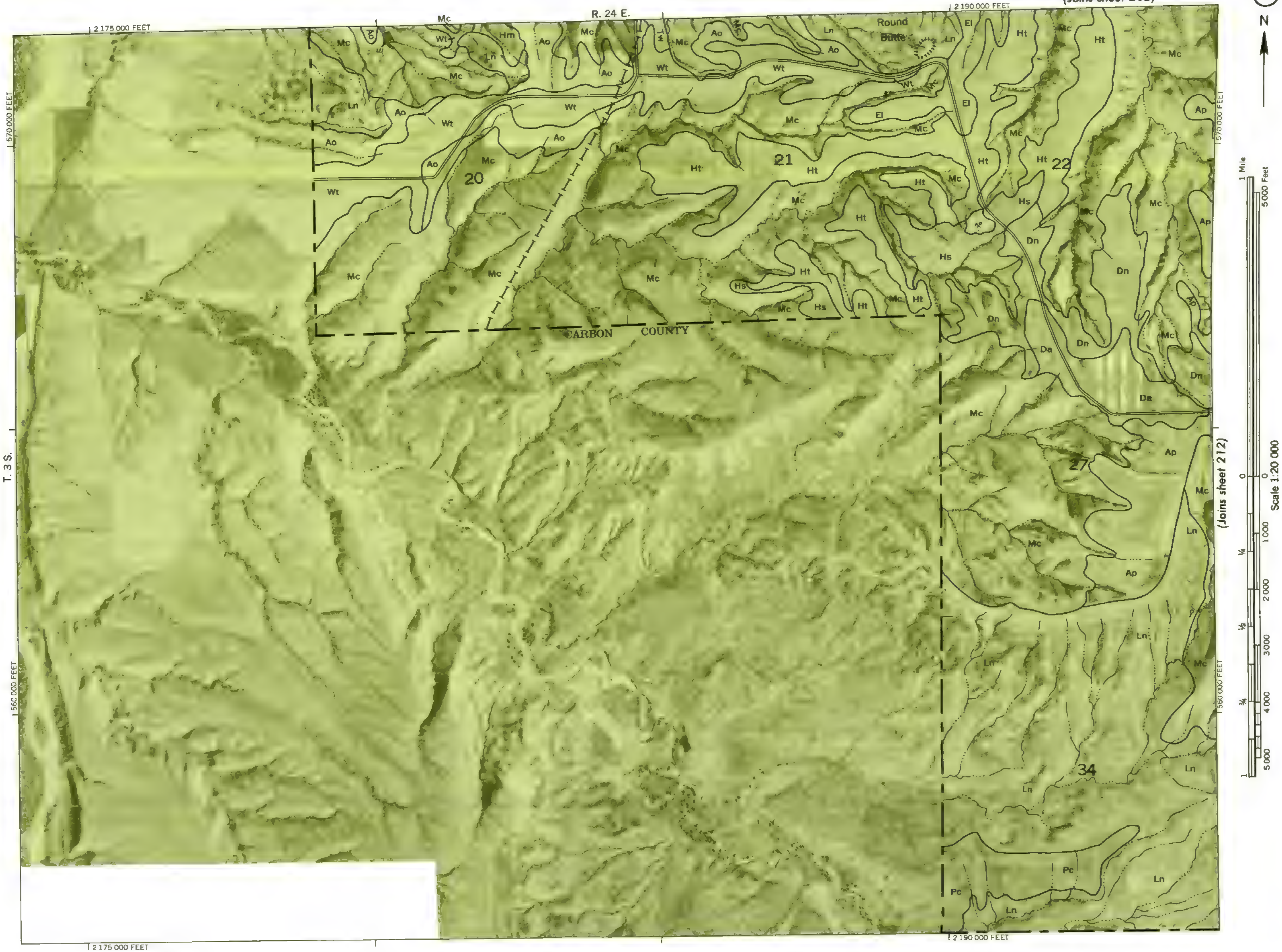


YELLOWSTONE COUNTY, MONTANA NO. 210

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 211

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 212

YELLOWSTONE COUNTY, MONTANA NO. 212

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

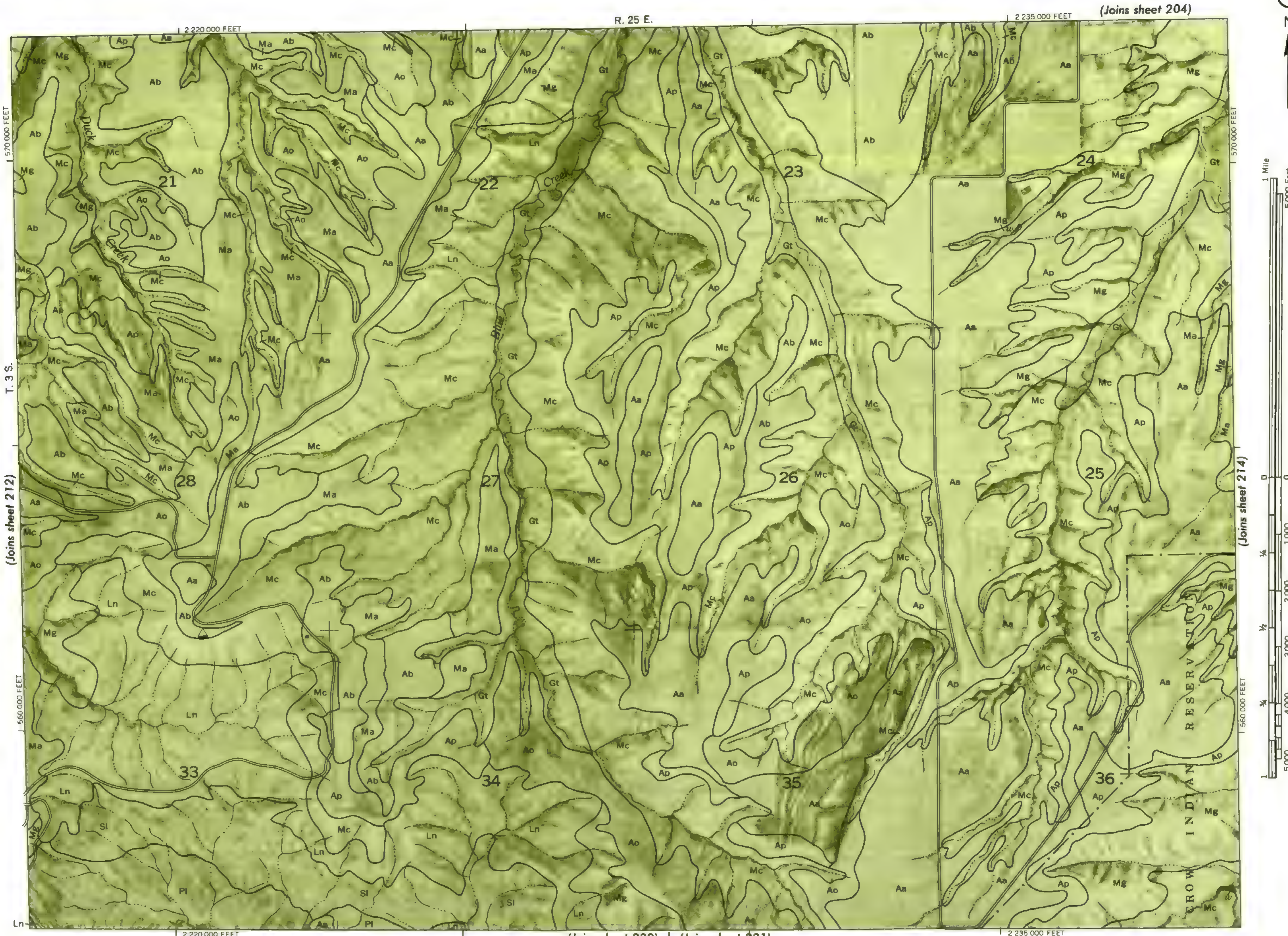
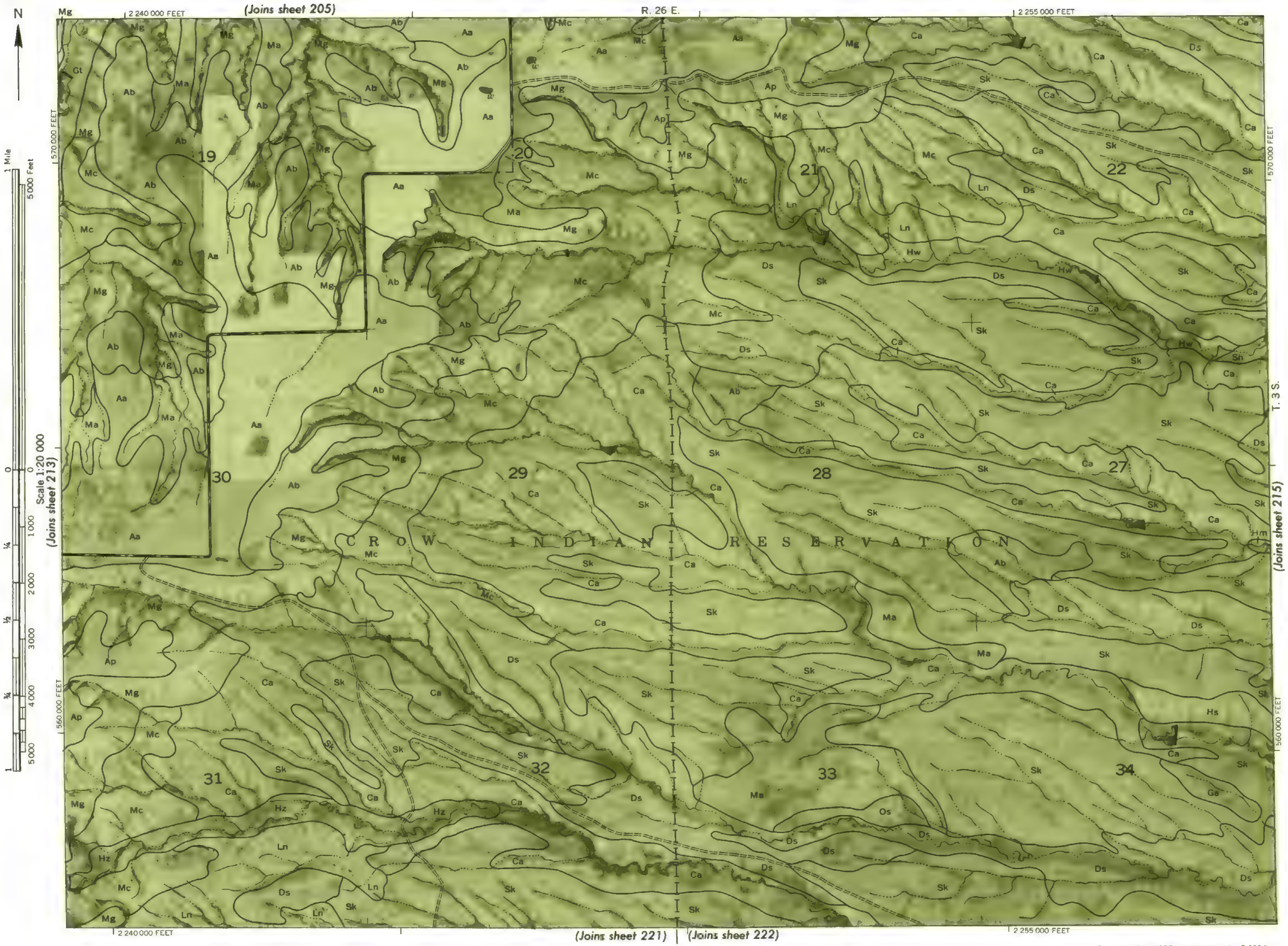


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 213

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 214



YELLOWSTONE COUNTY, MONTANA NO. 214

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

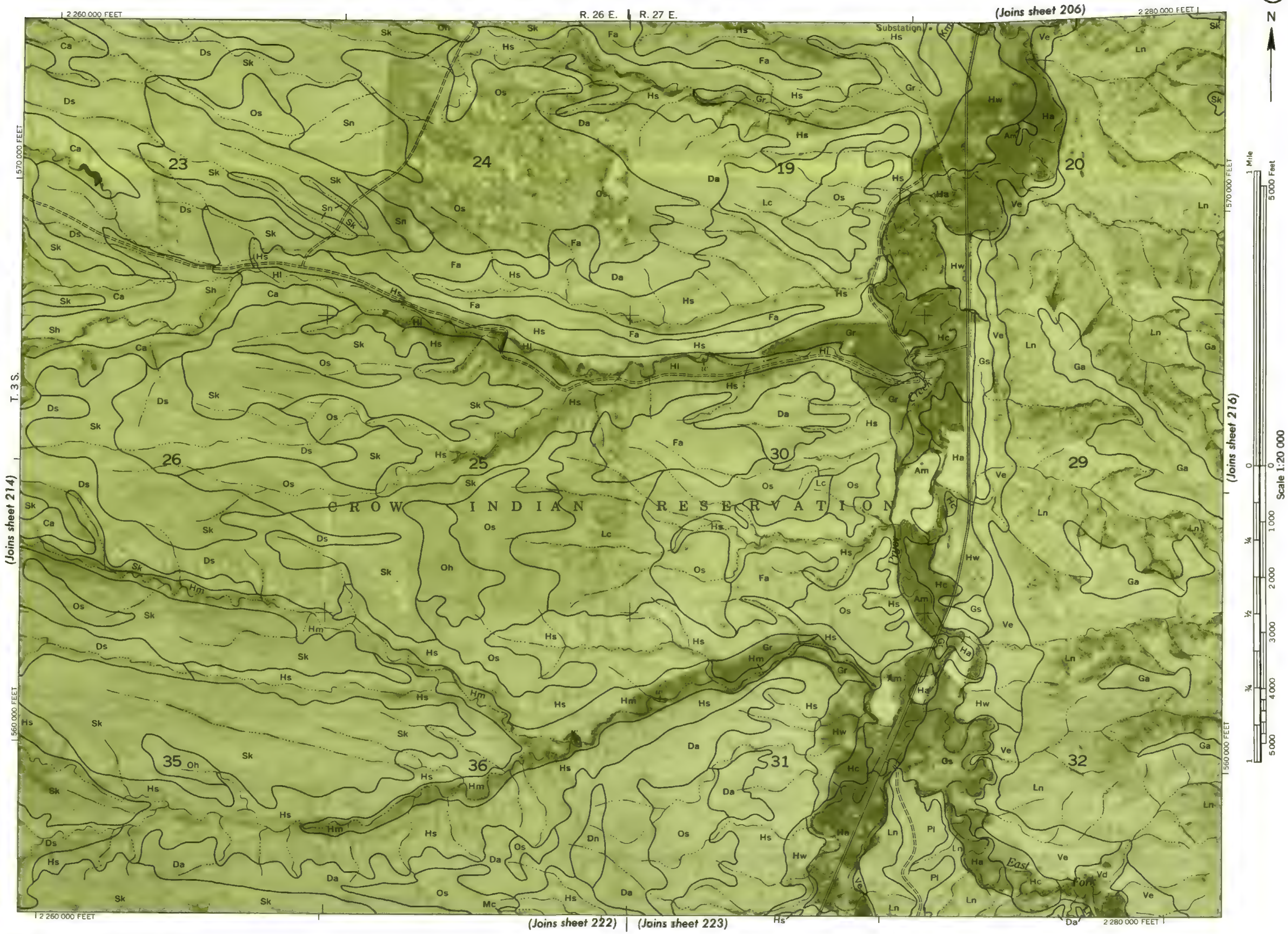


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 216

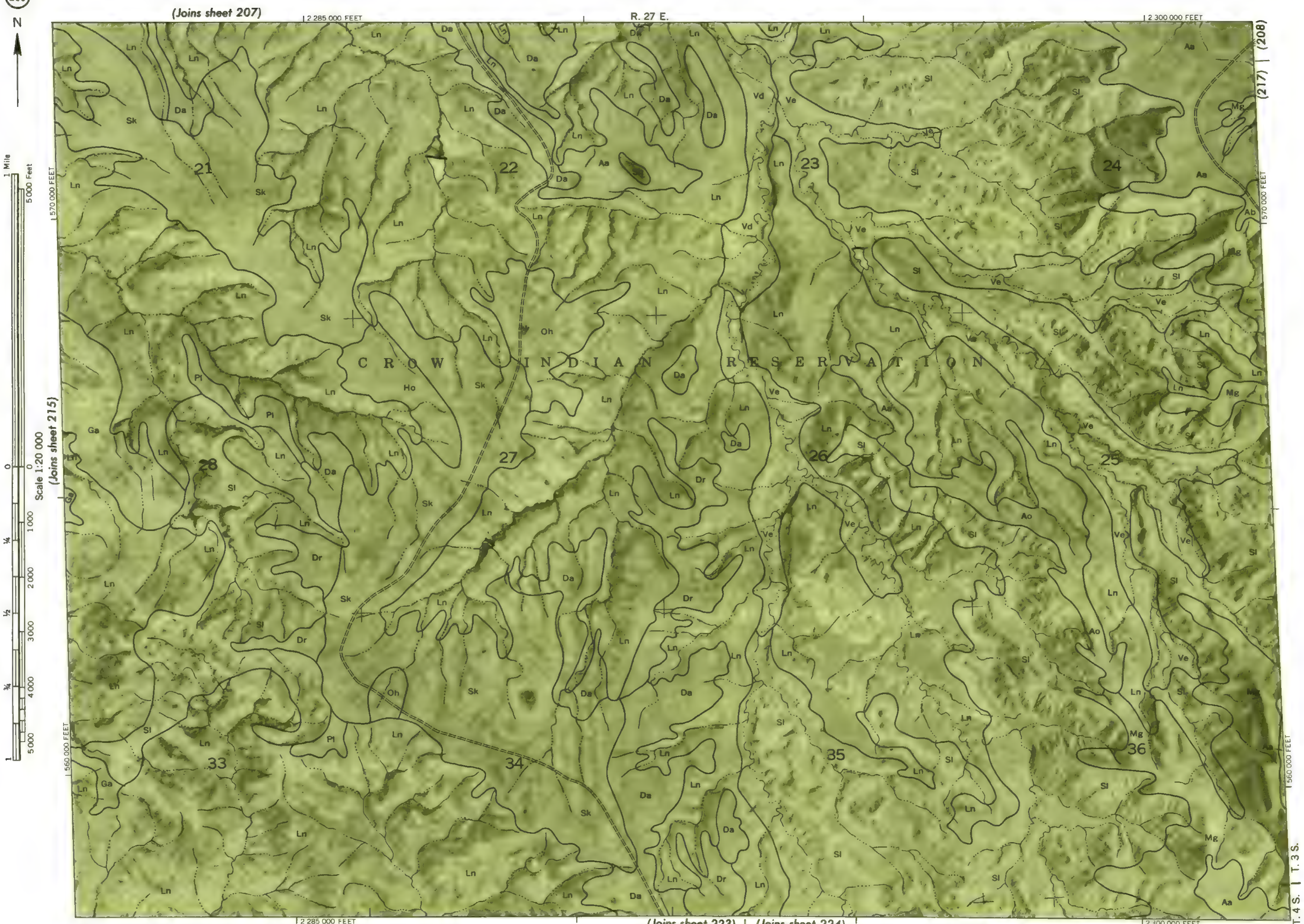
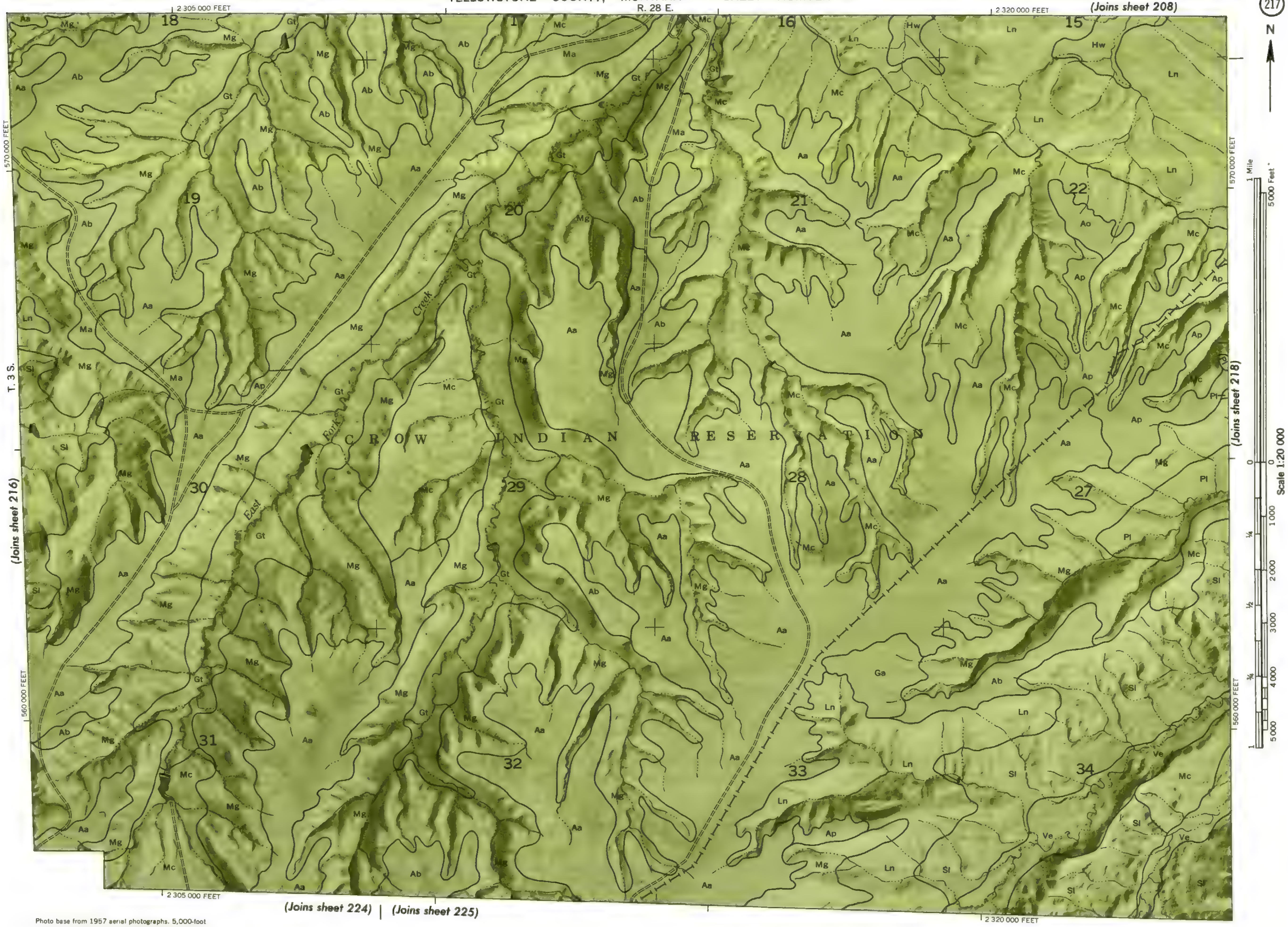


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 216

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 217

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 218

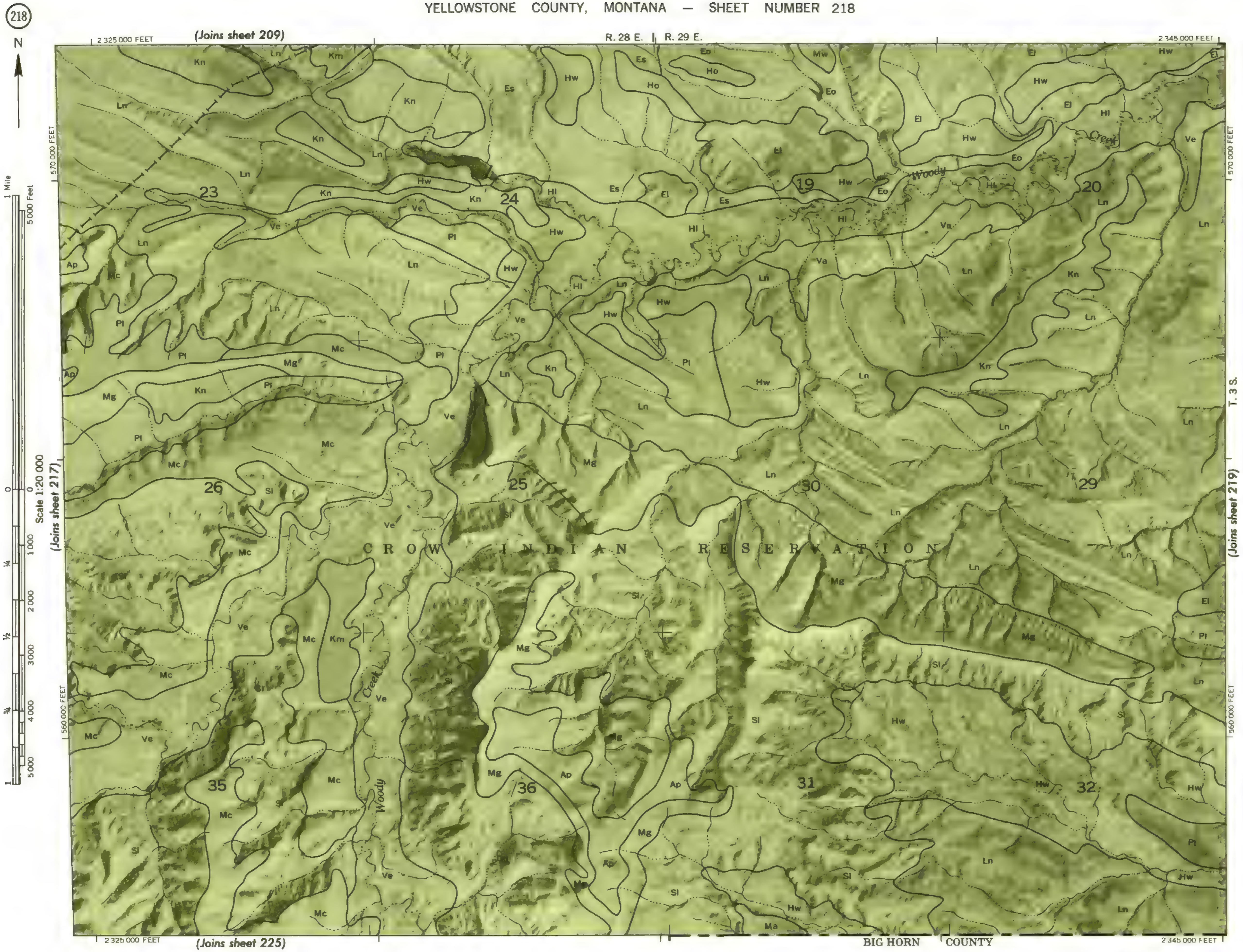


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 218

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 219

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 22

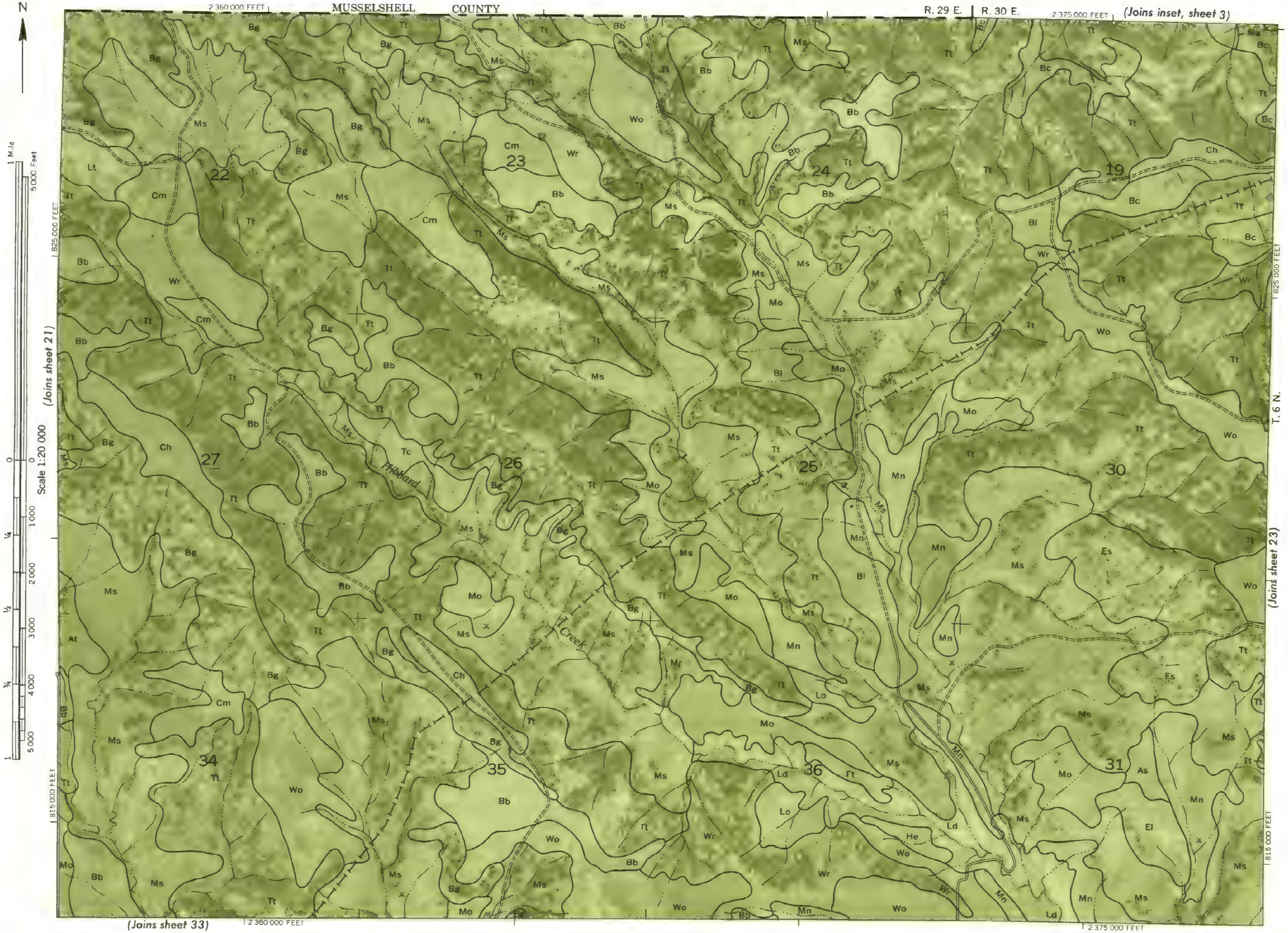


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 22

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

220

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 220

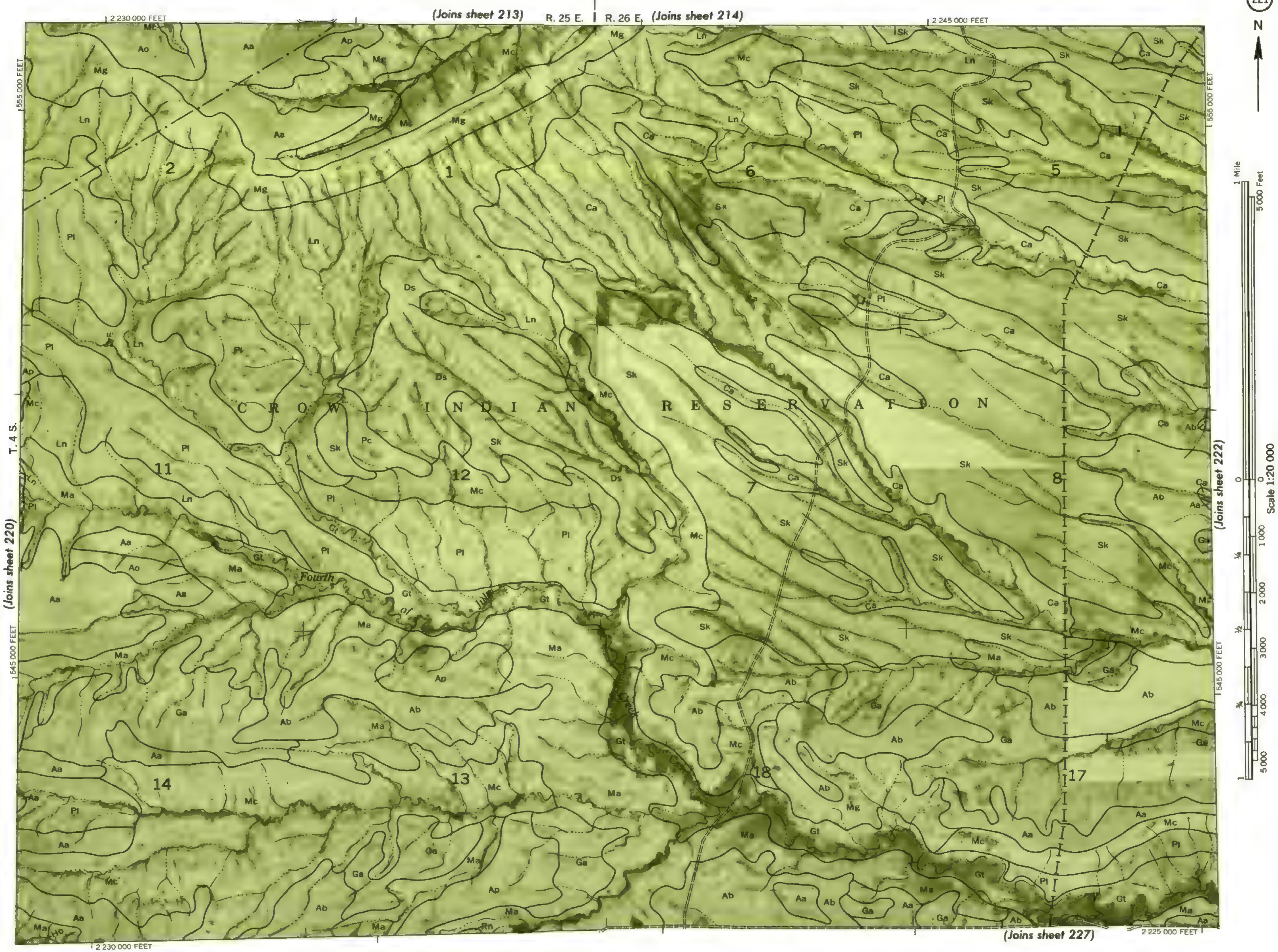
YELLOWSTONE COUNTY, MONTANA NO. 220

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 221



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

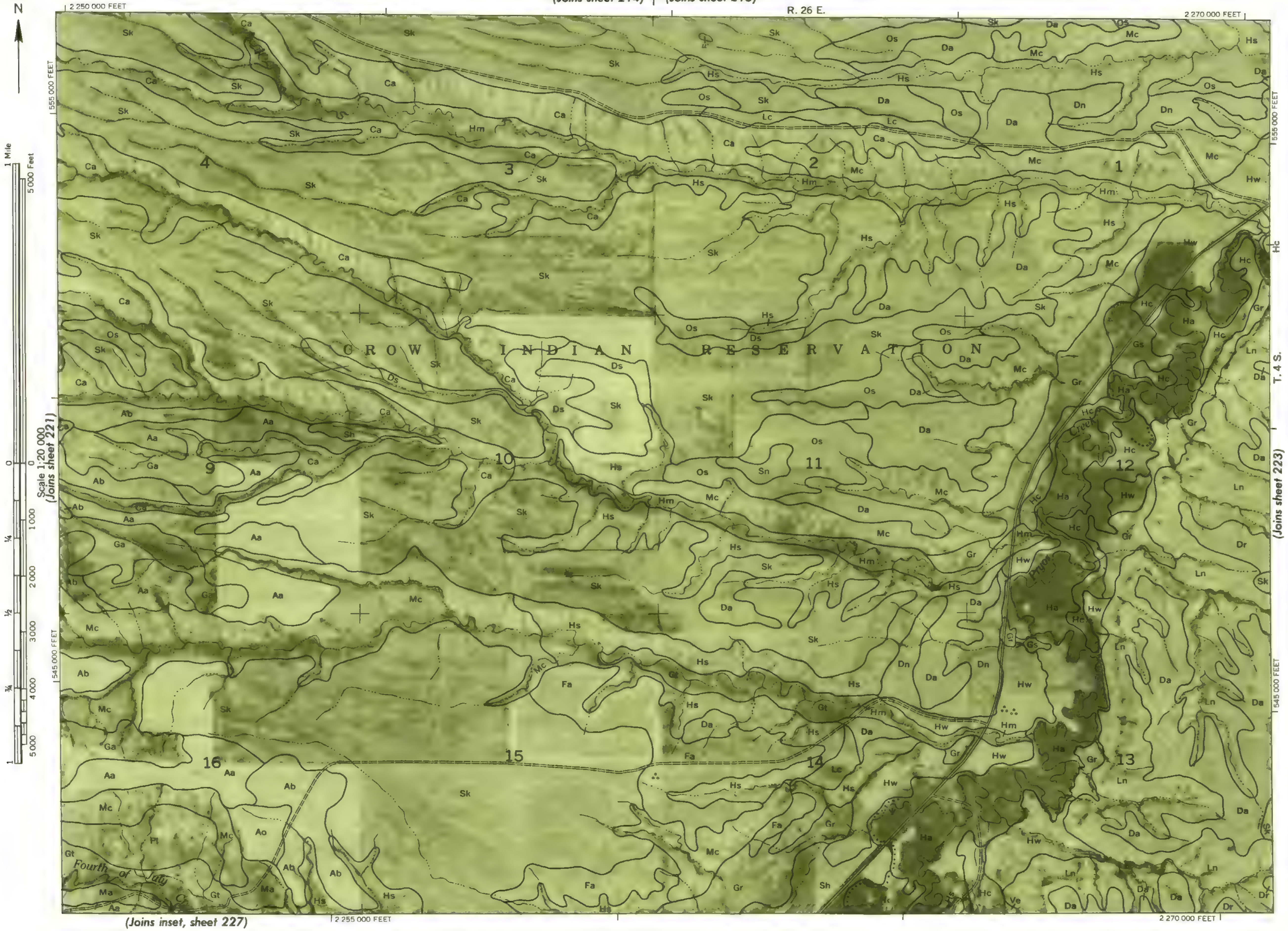
YELLOWSTONE COUNTY, MONTANA NO. 221

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

(222)

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 222

(Joins sheet 214) | *(Joins sheet 215)*



(Joins inset, sheet 227)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 222

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

(Joins sheet 215) | (Joins sheet 216)

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 223

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 224

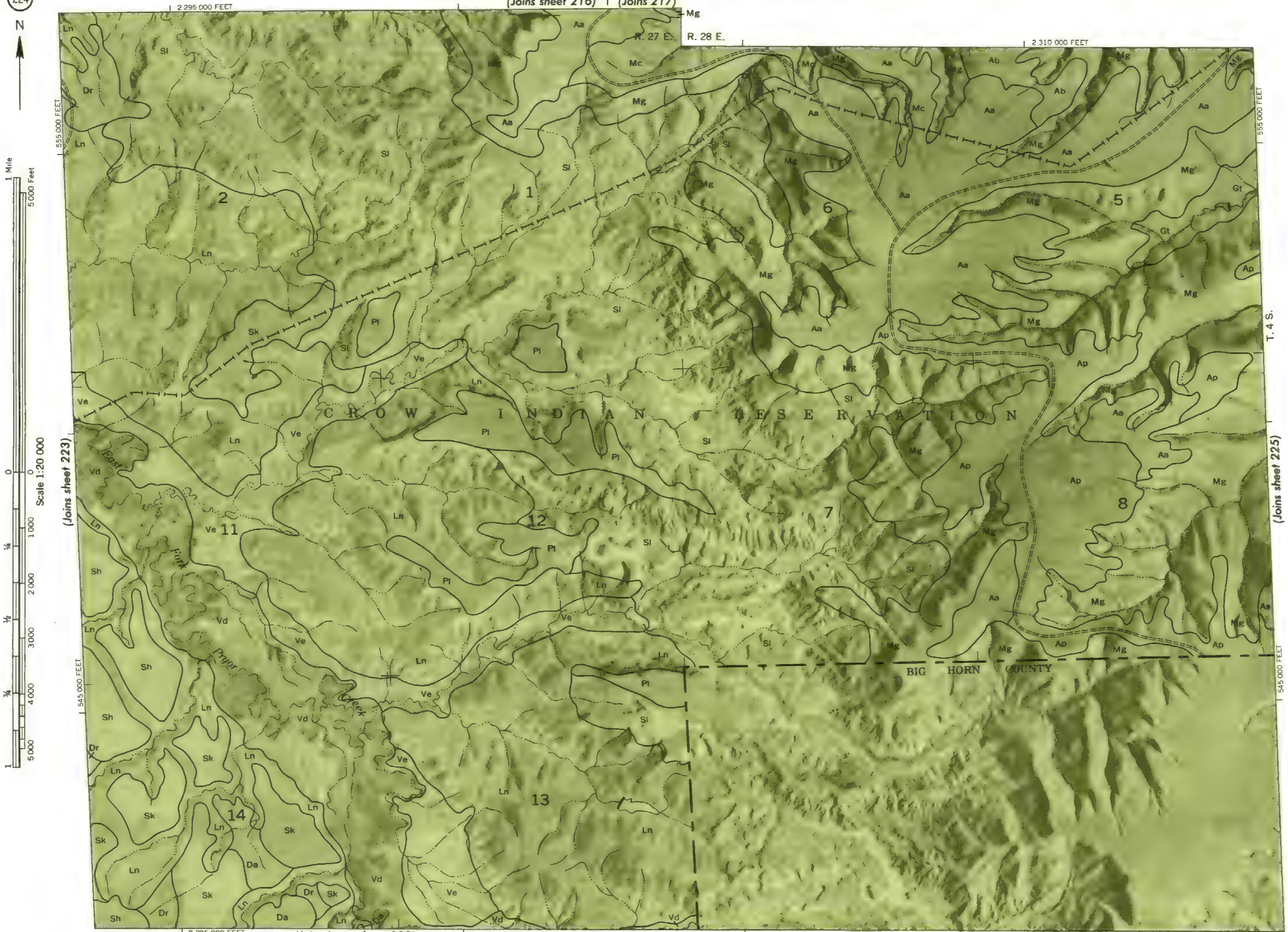


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 224

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

(Joins sheet 217) | (Joins sheet 218)

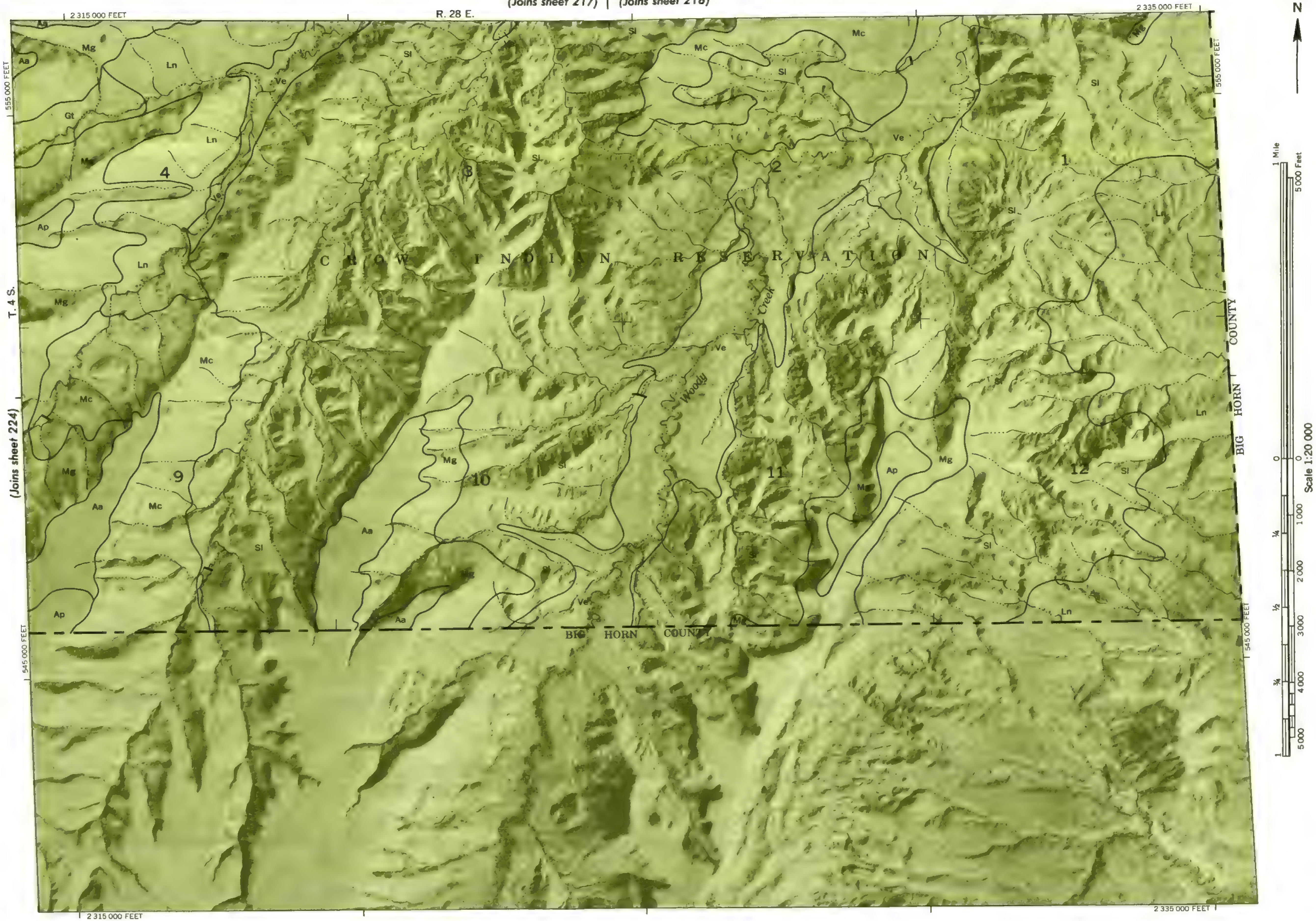
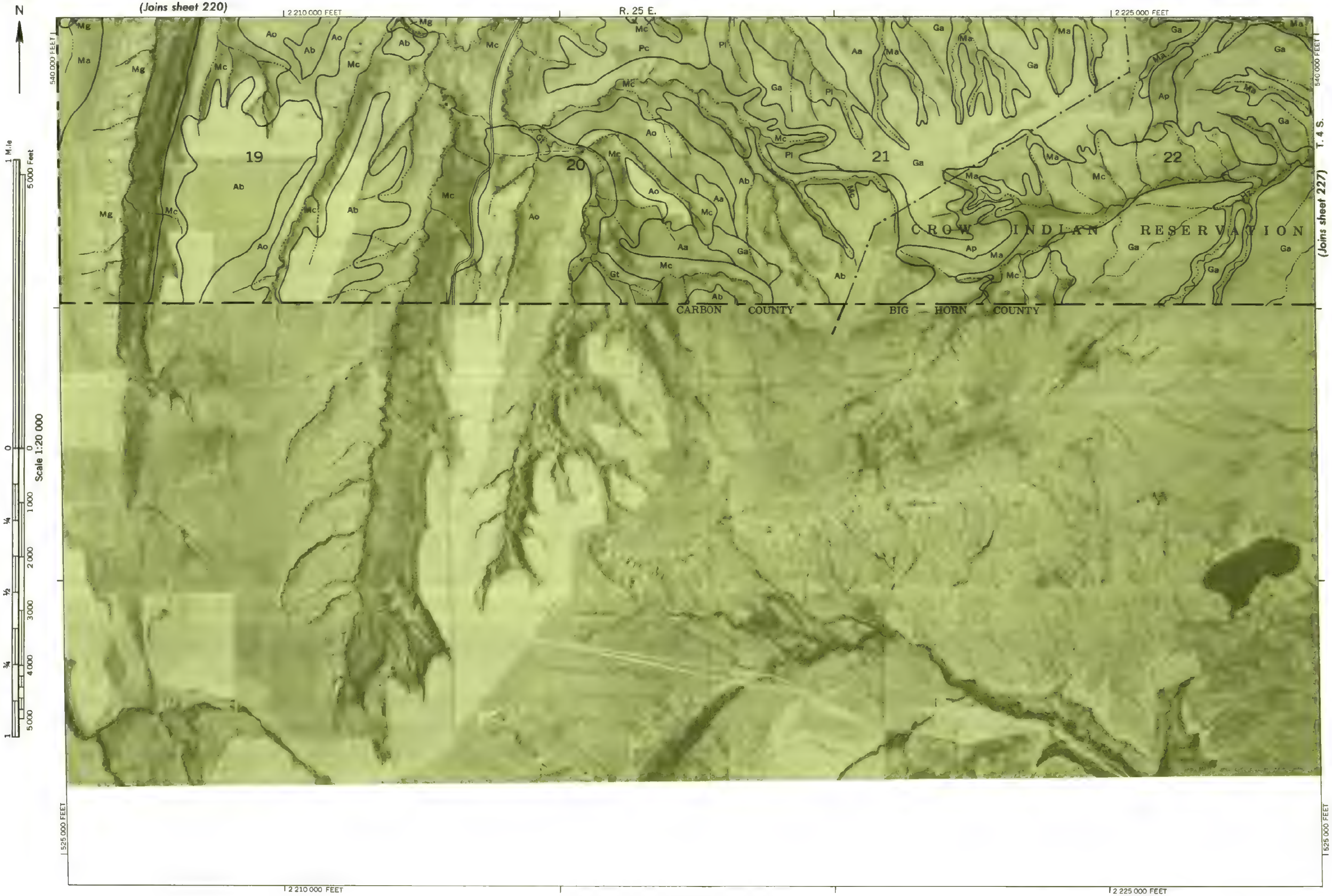


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 225

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 226

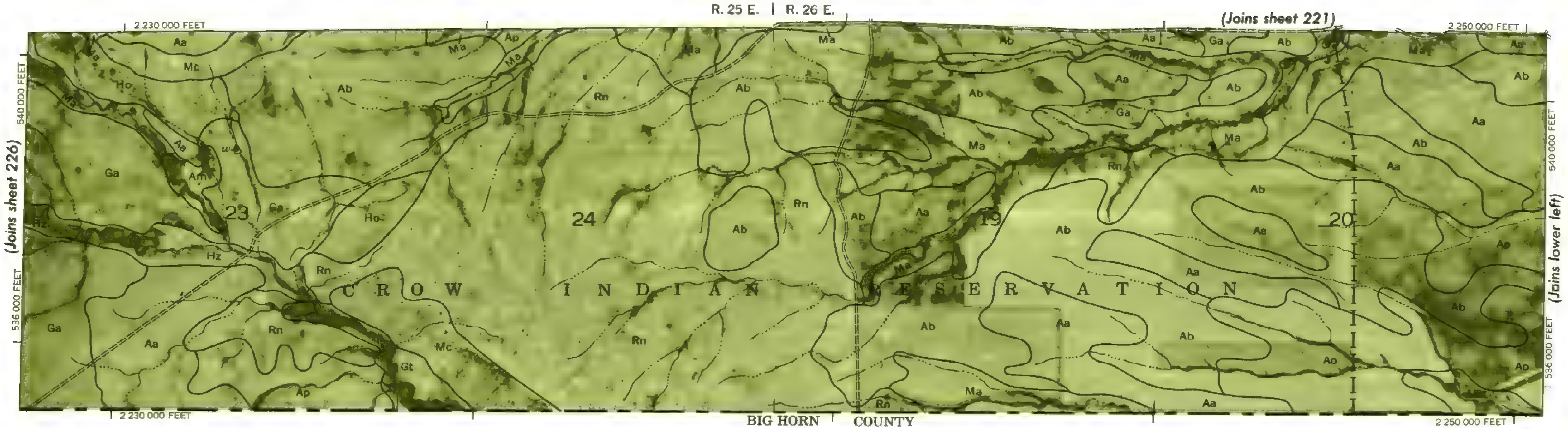


YELLOWSTONE COUNTY, MONTANA NO. 226

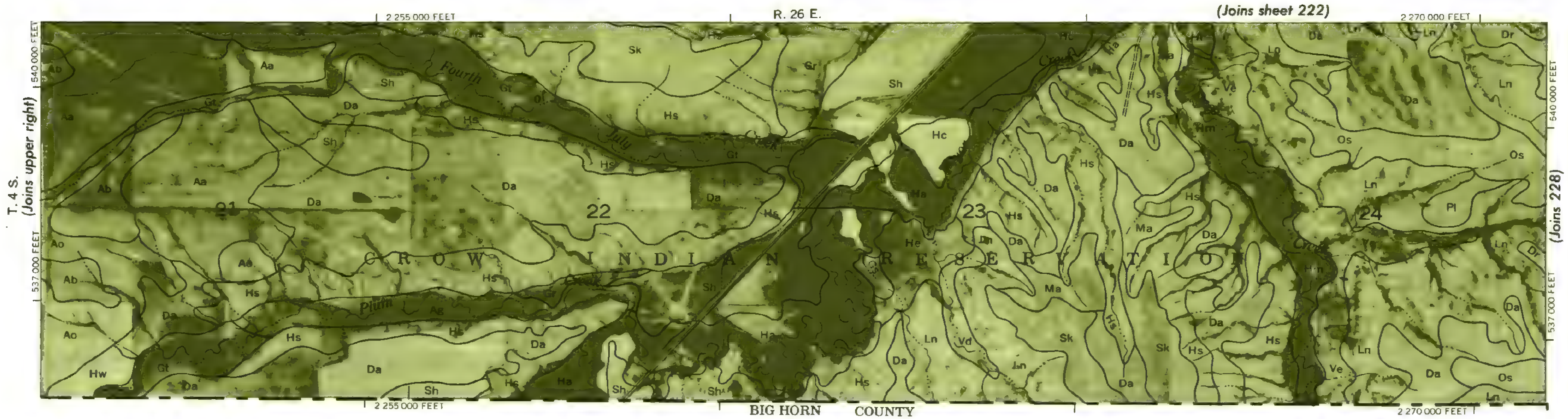
Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



GRID TICK INTERVAL 4000 FEET ON NORTH-SOUTH LINE



GRID TICK INTERVAL 3000 FEET ON NORTH-SOUTH LINE

N

Scale 1:20 000

1 Mile ¾ ½ ¼ 0

5000 Feet 4000 3000 2000 1000 0

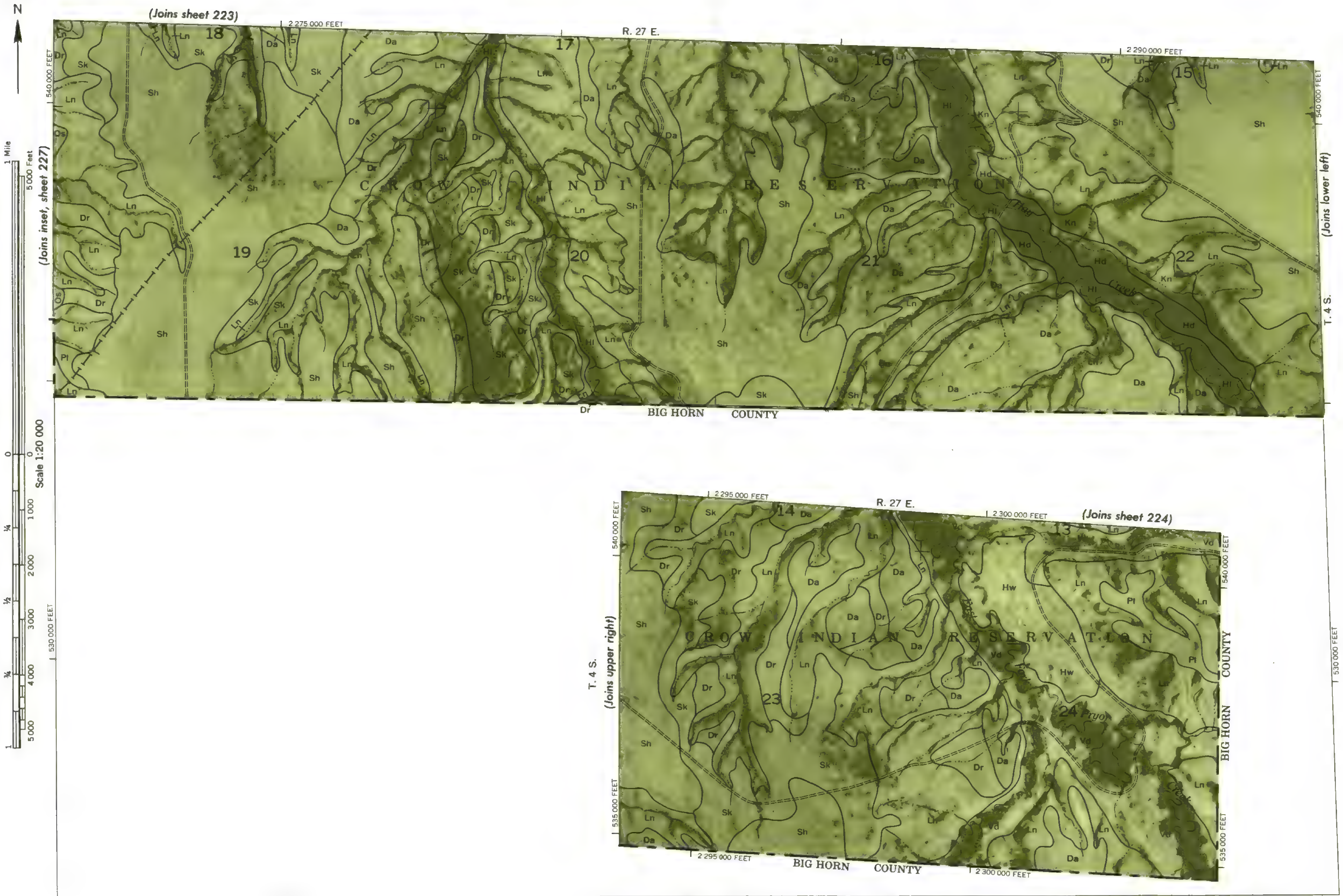
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 227

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 228



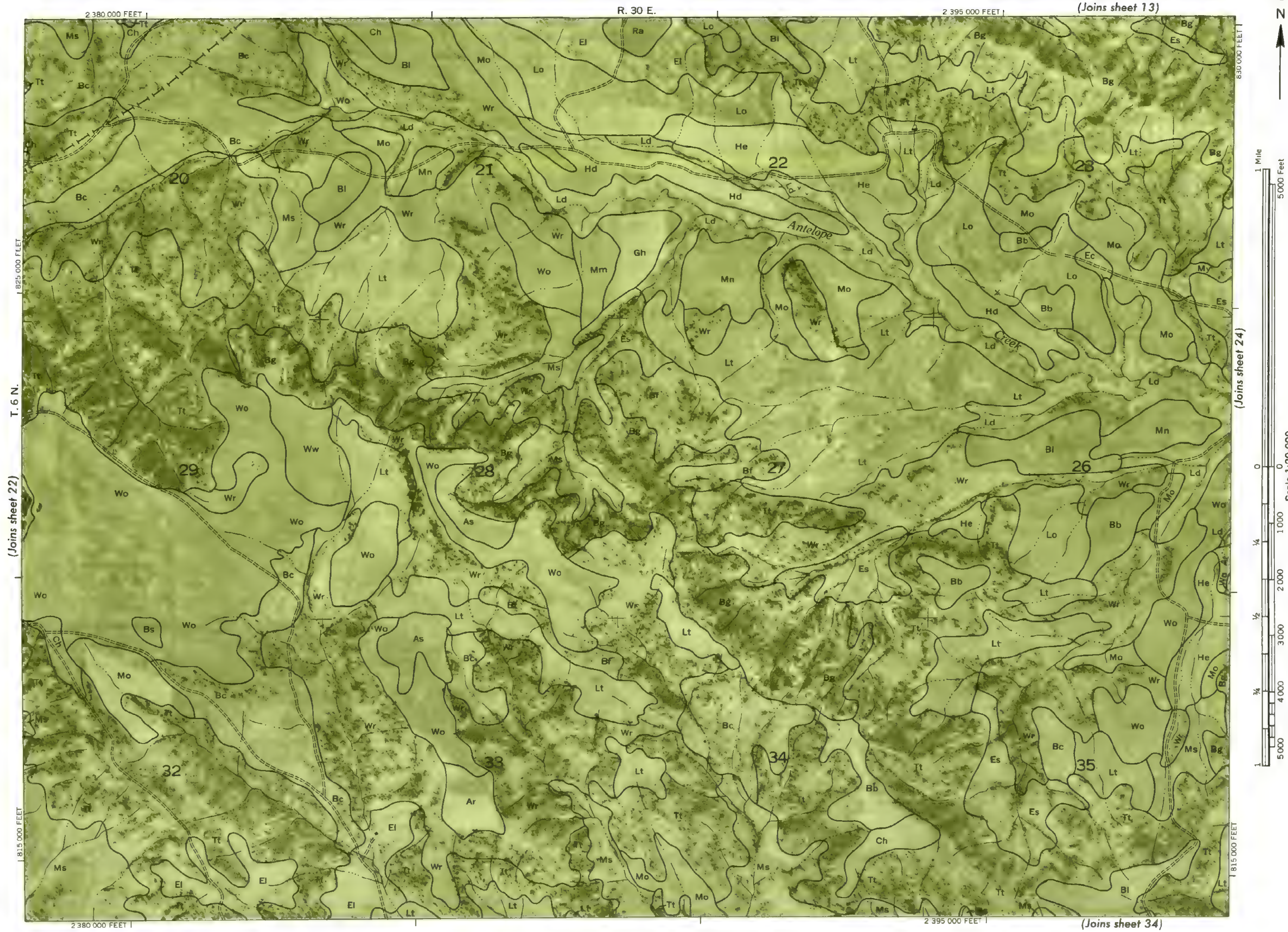
YELLOWSTONE COUNTY, MONTANA NO. 228

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

(23)

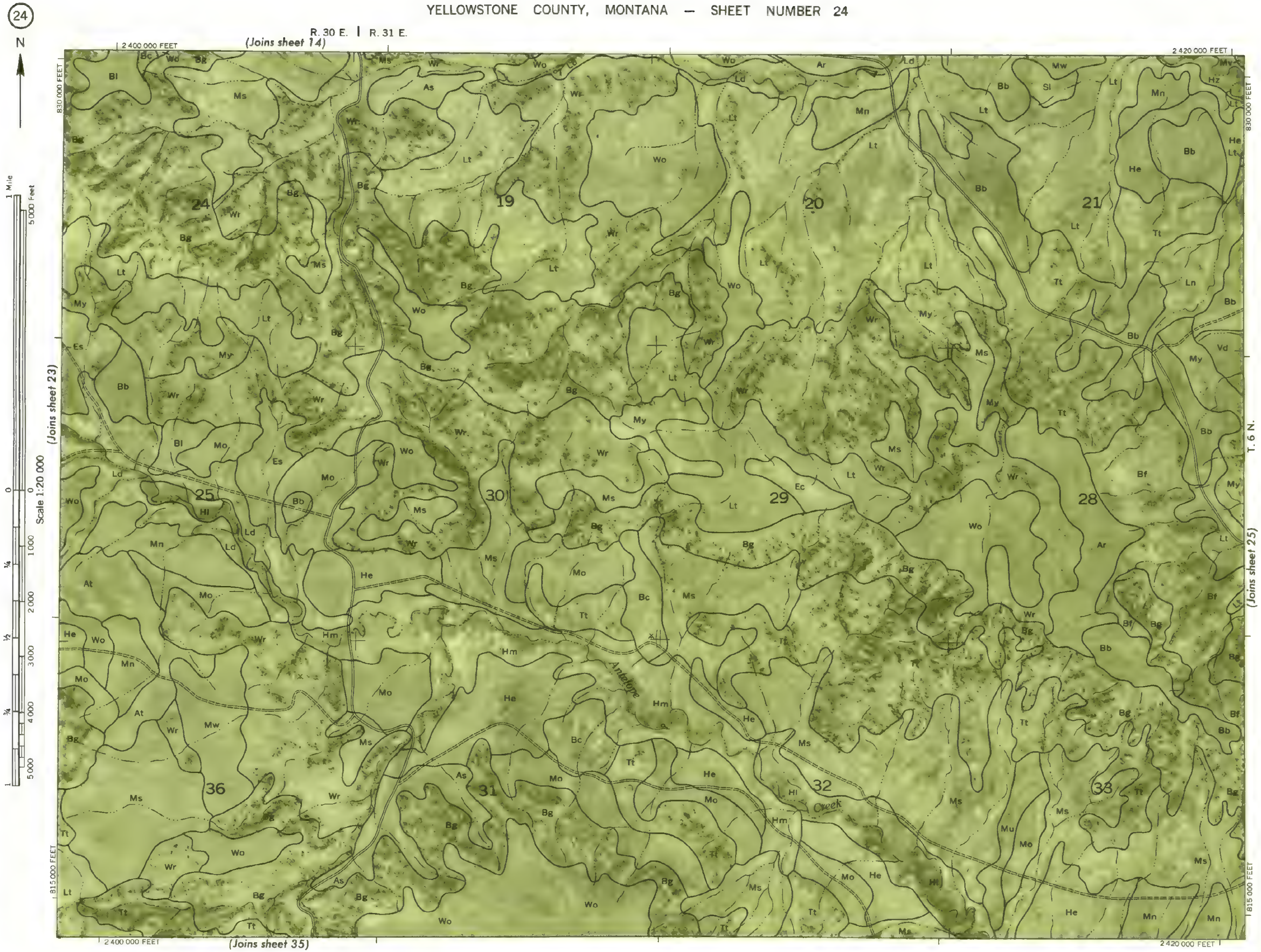


This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 23

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 24



YELLOWSTONE COUNTY, MONTANA NO. 24

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

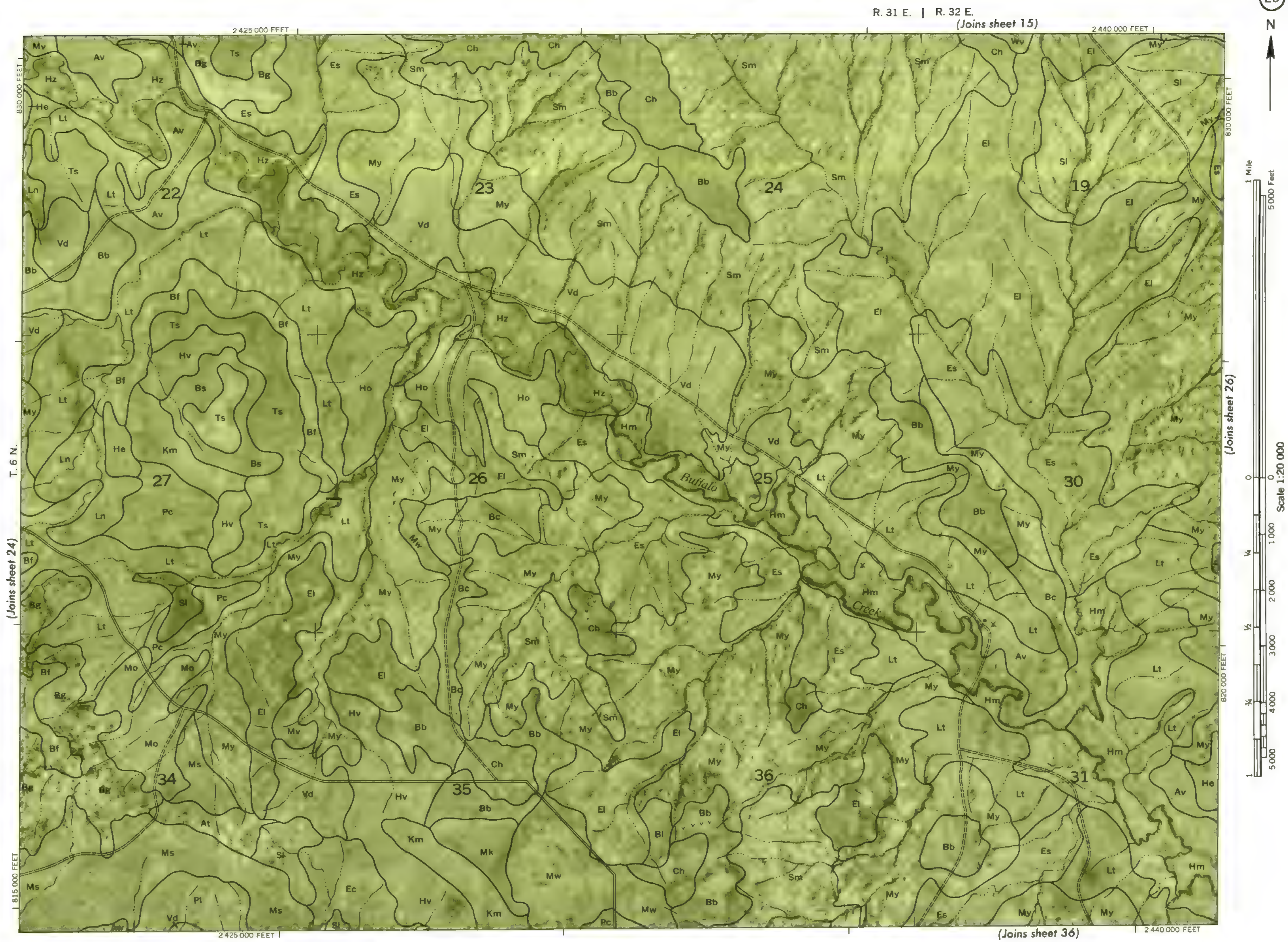


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 25

26

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 26

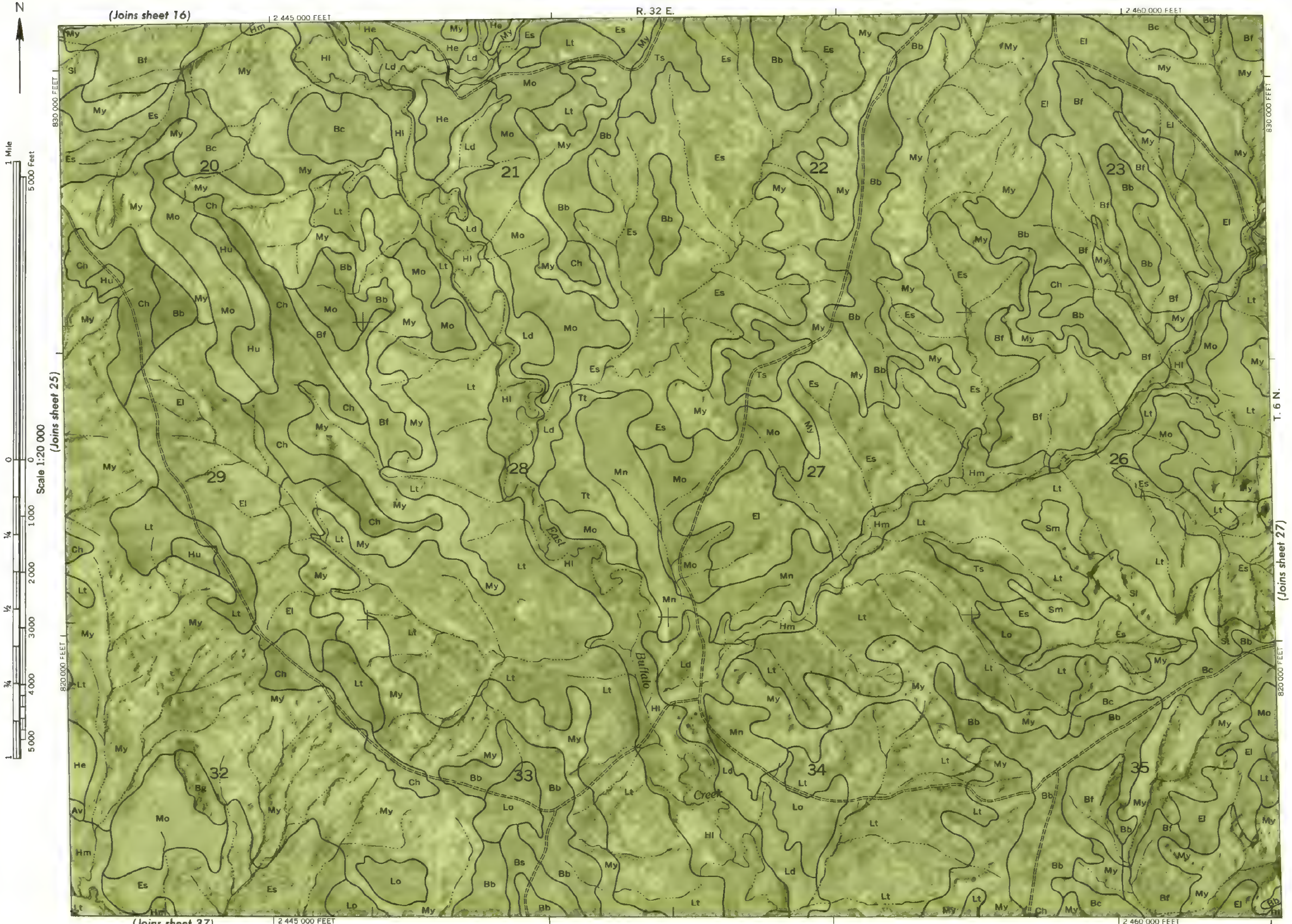
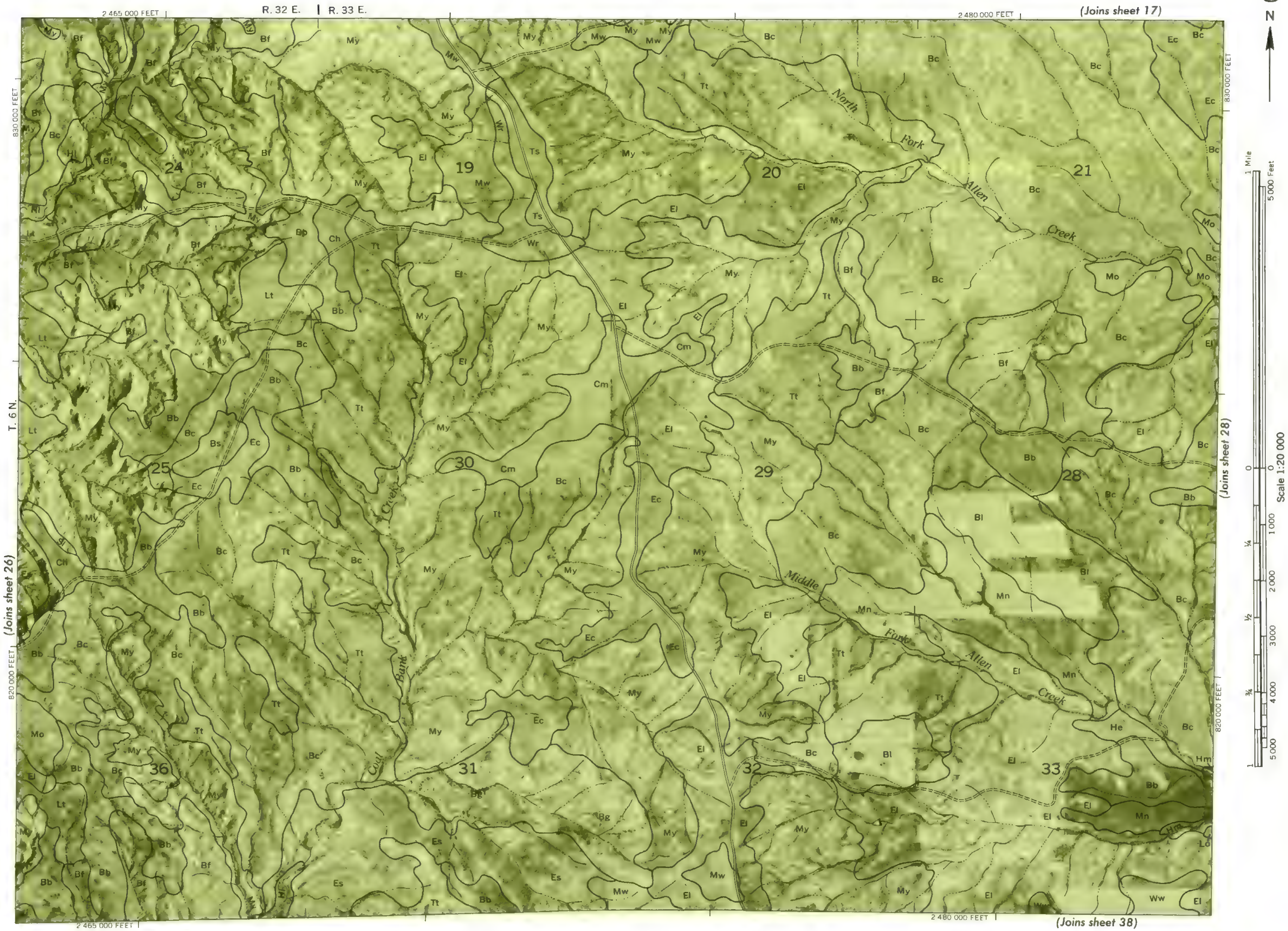


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 26

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

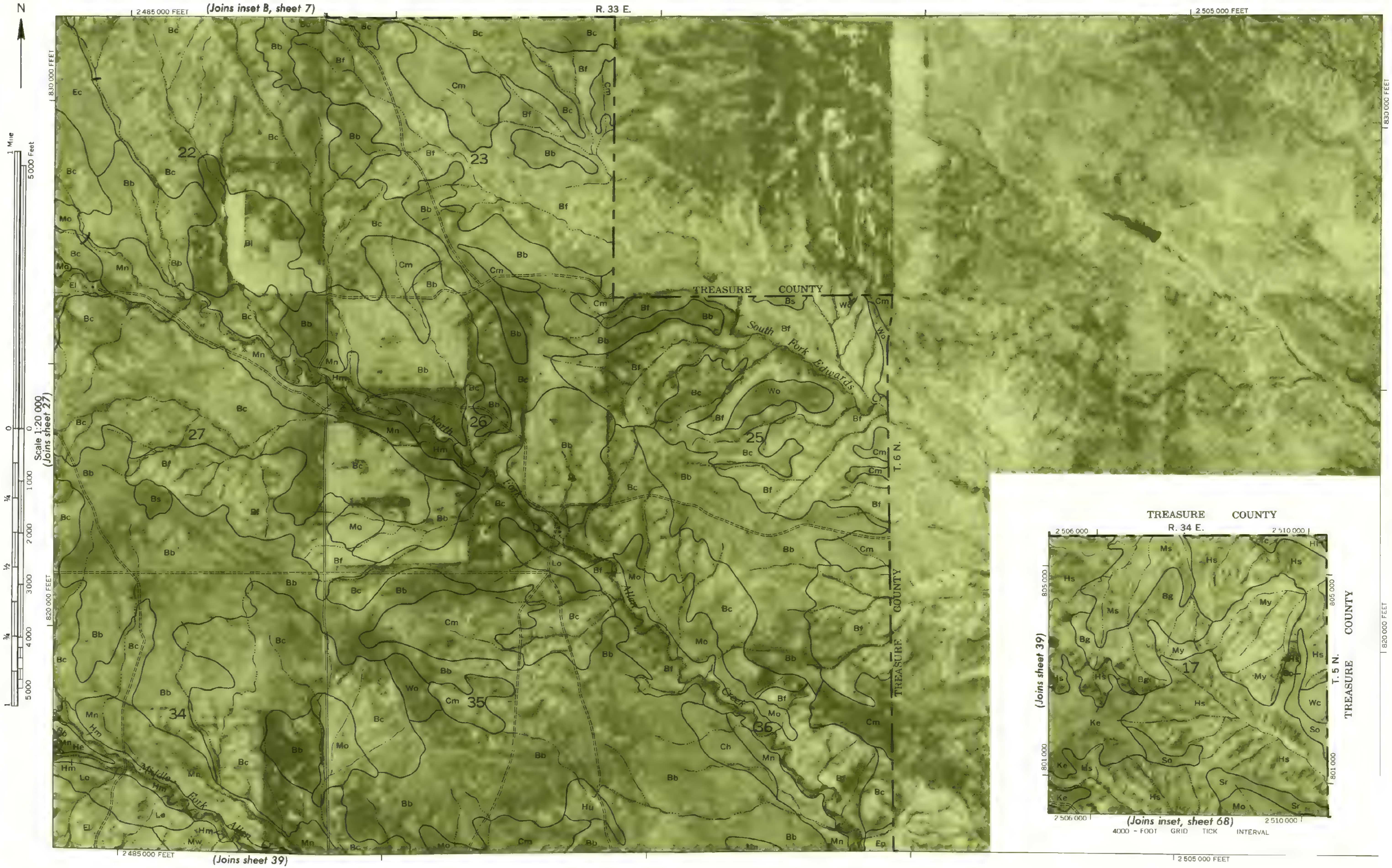


This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA NO. 27

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 28



YELLOWSTONE COUNTY, MONTANA NO. 28

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service and the Montana Agricultura Experiment Station

Photo base from 1957 aerial photographs 5,000-foot grid t cks based on Montana plane coordinate system, south zone 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 29

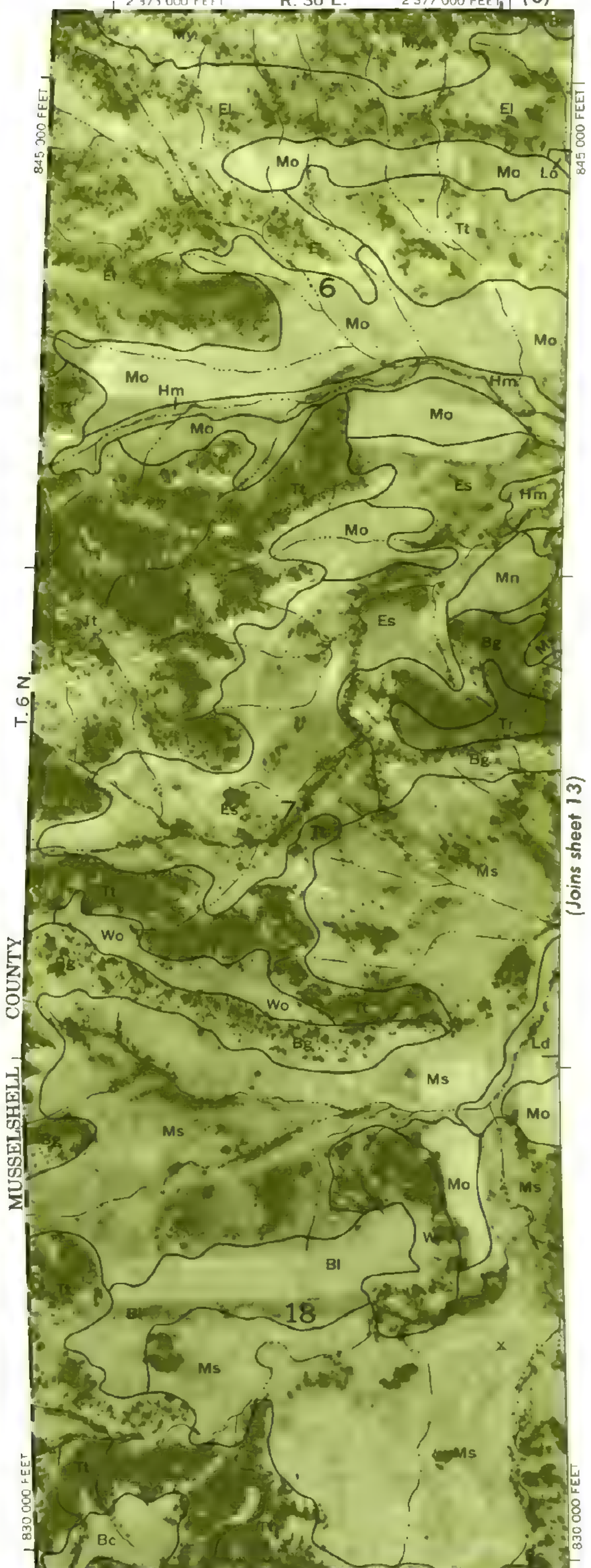
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

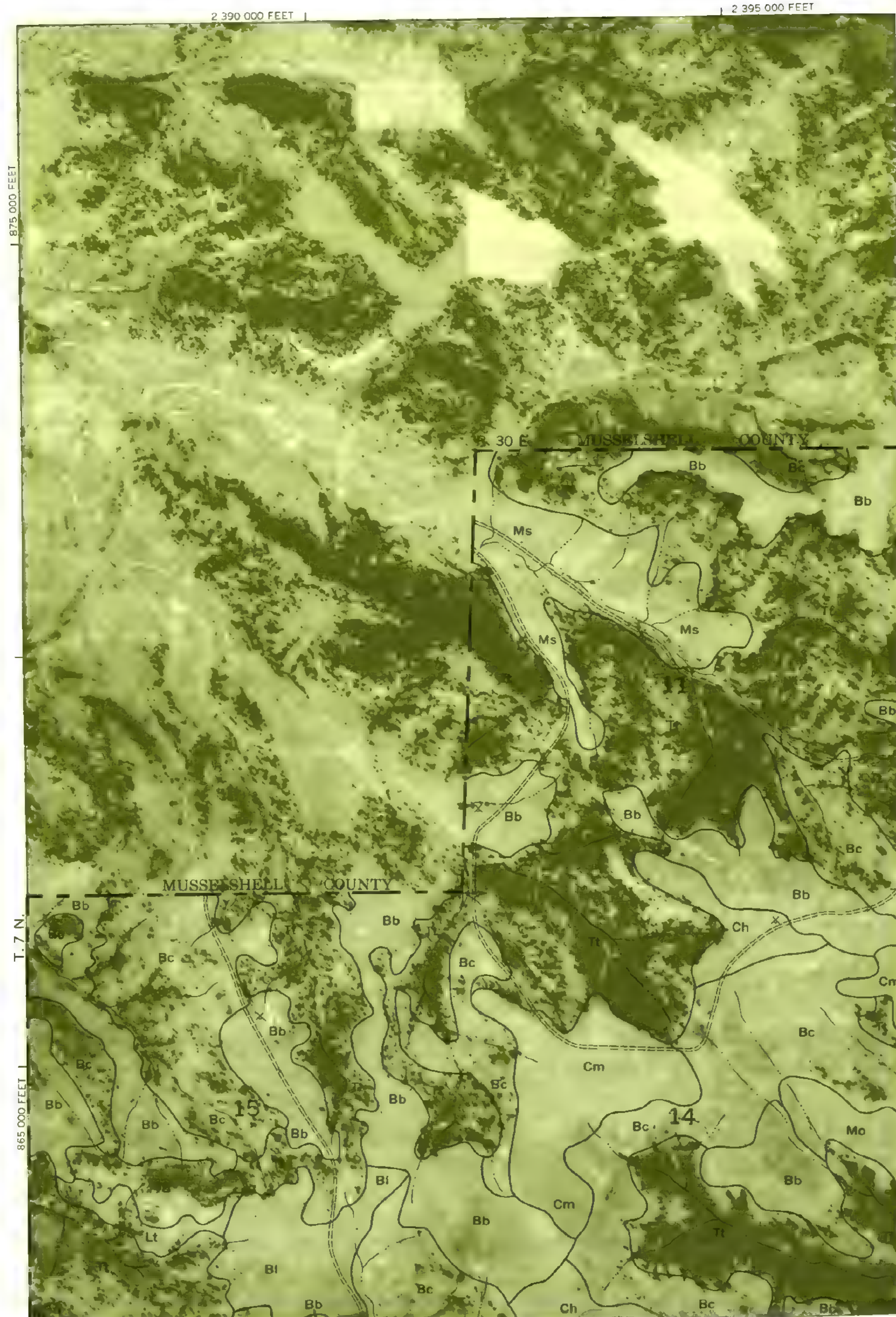
3

N

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 3





1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
Scale 1:20 000

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

GRID TICK INTERVAL 4000 FEET ON EAST WEST LINE

(30)

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 30

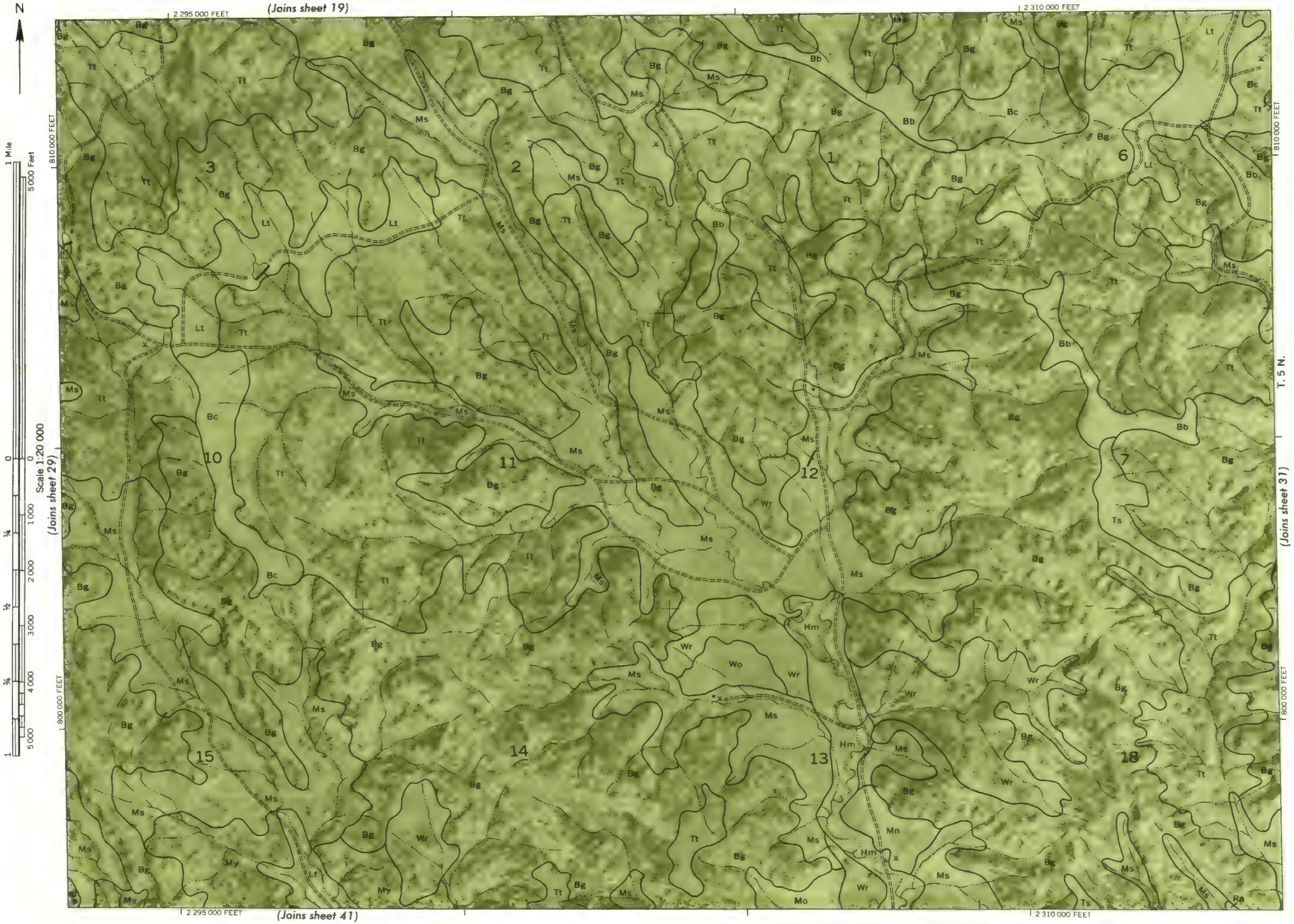


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 30

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

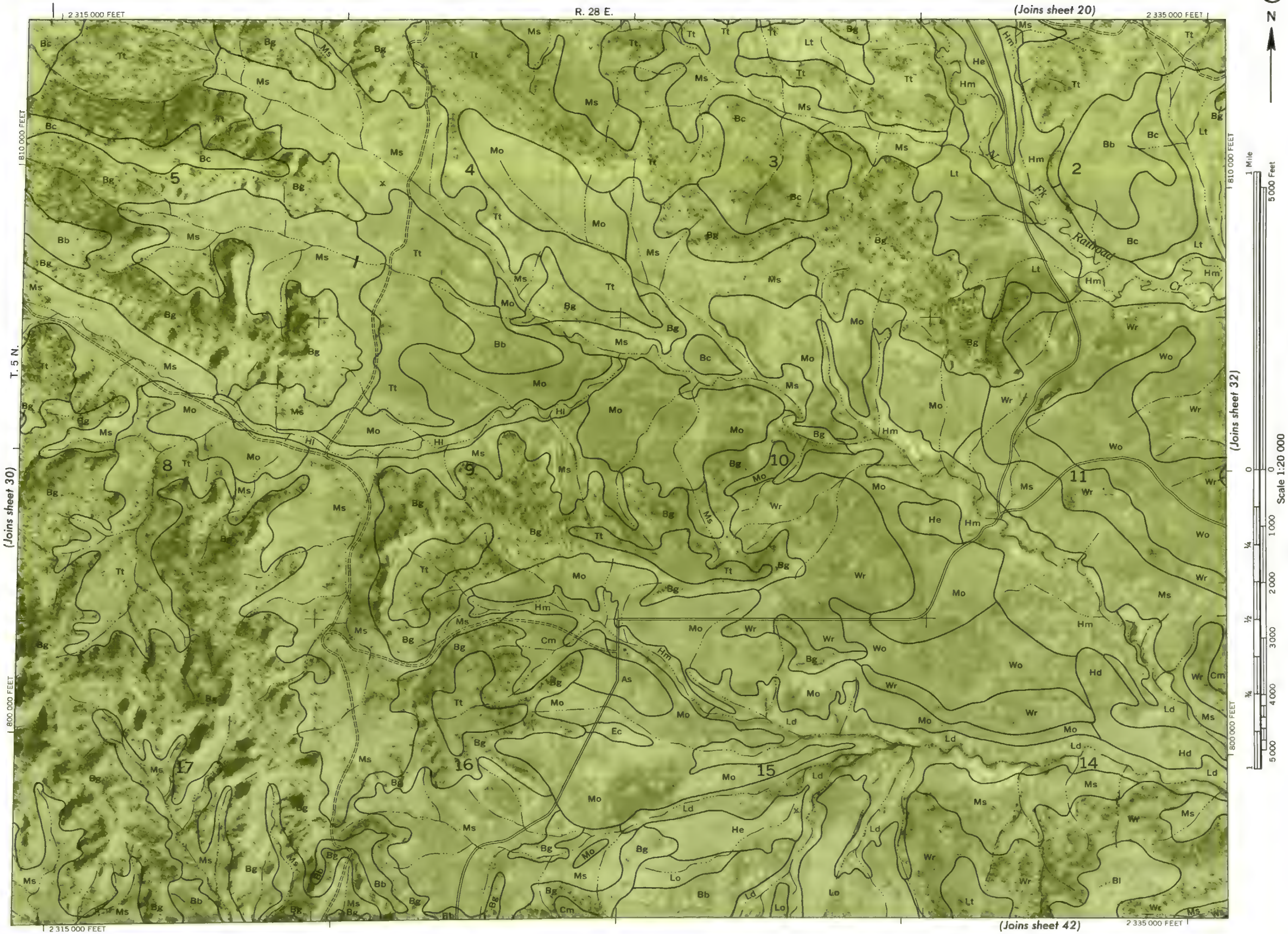
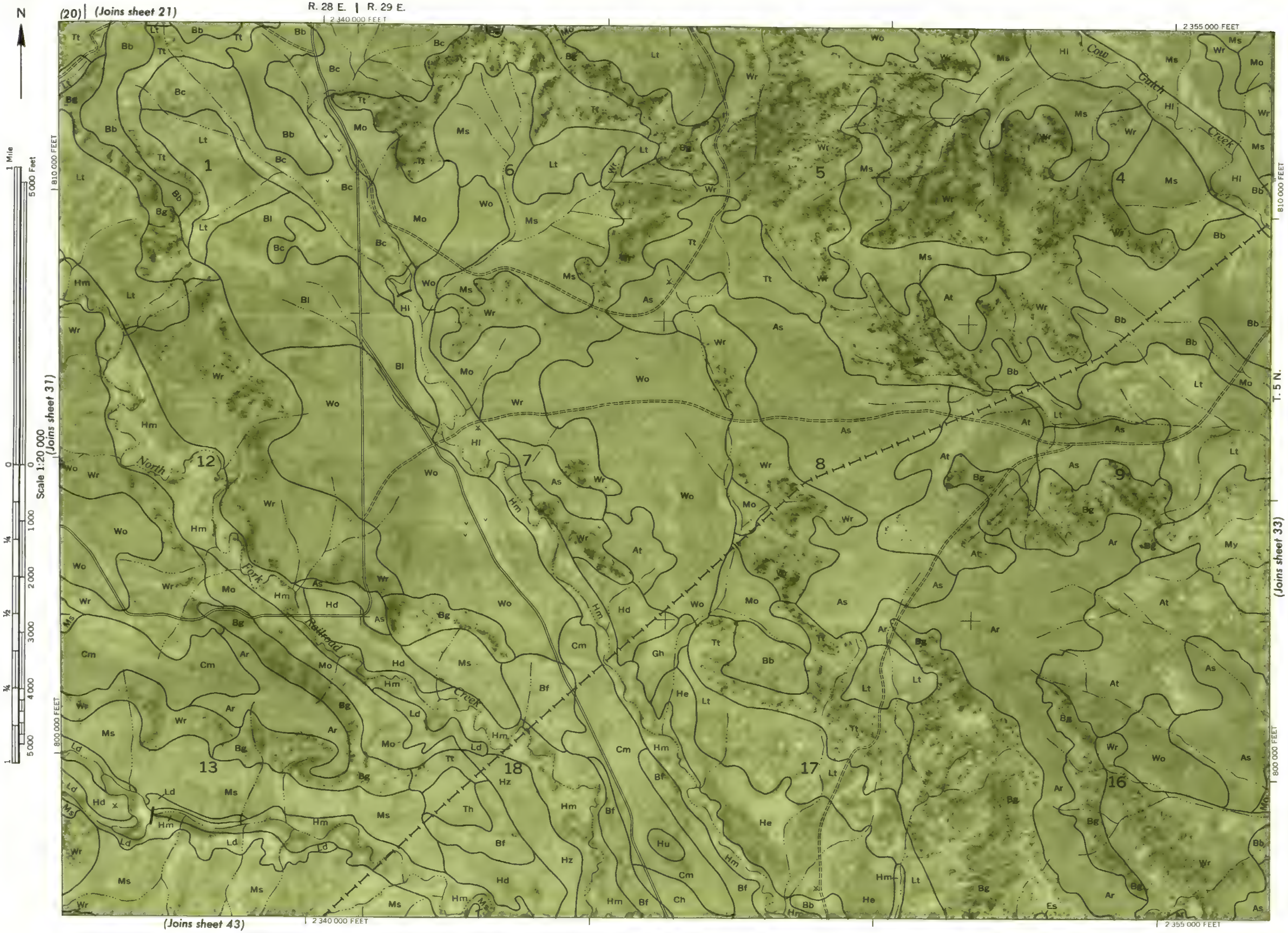


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 31



YELLOWSTONE COUNTY, MONTANA NO. 32

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

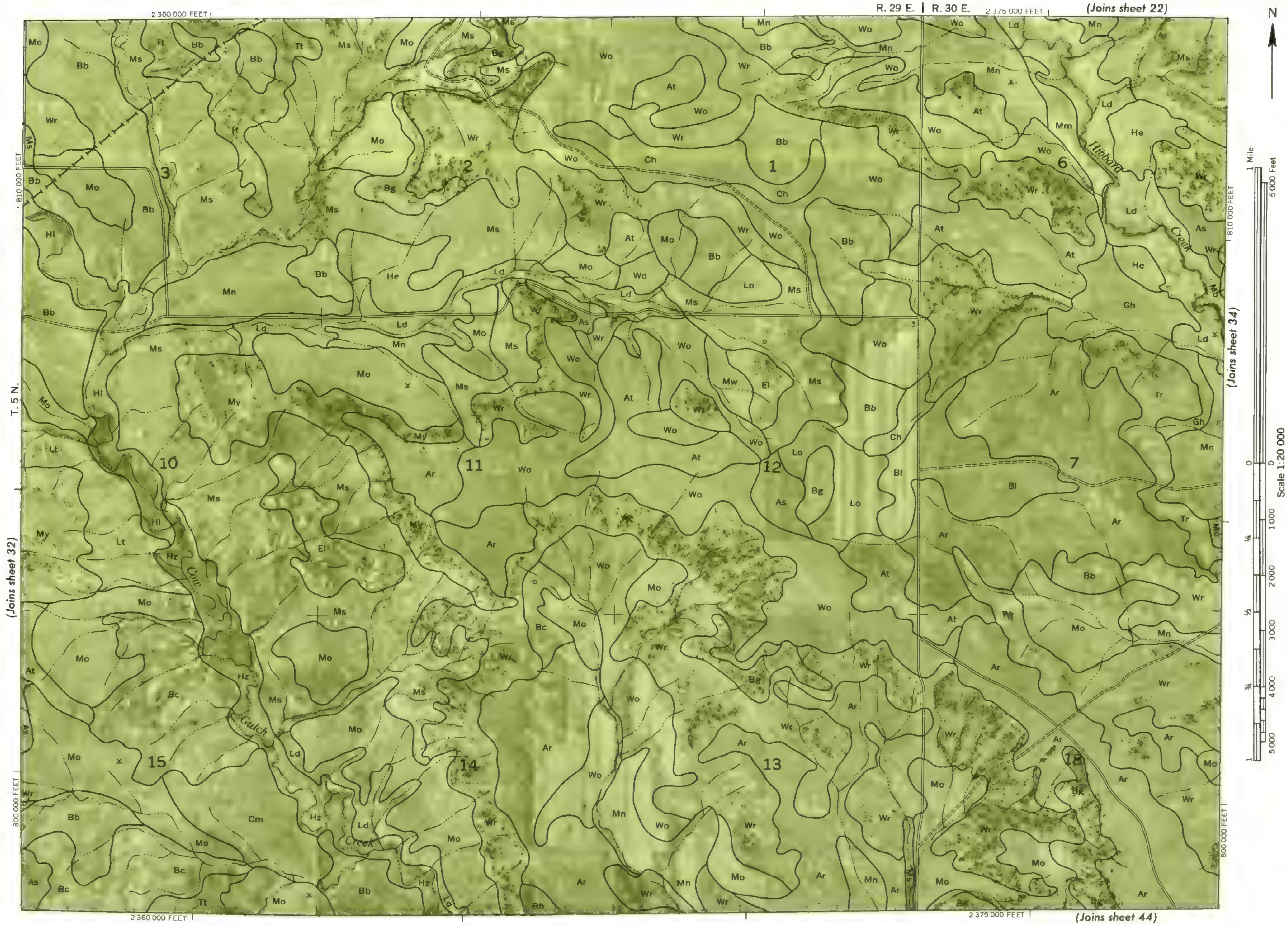
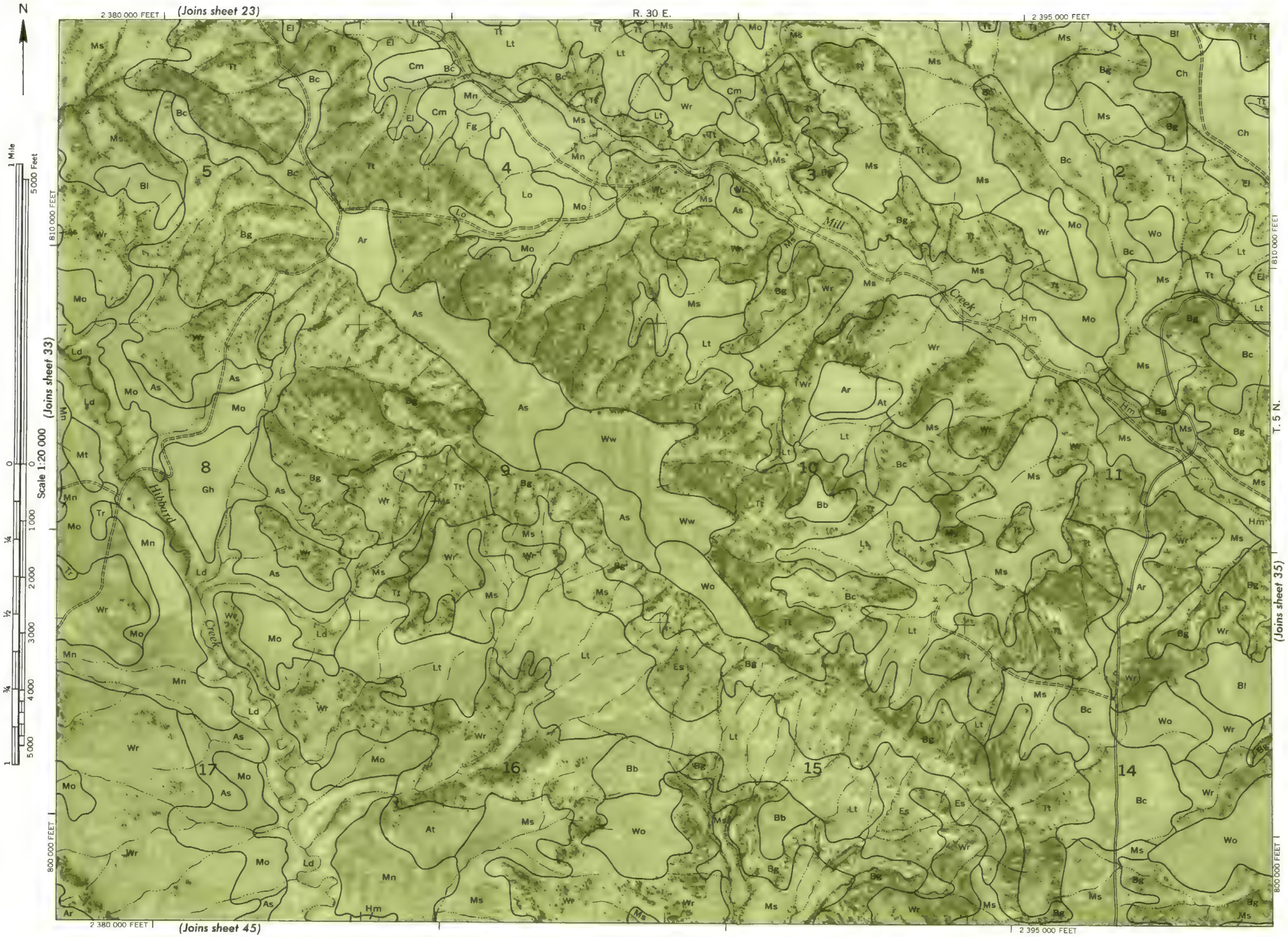


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 33

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 34

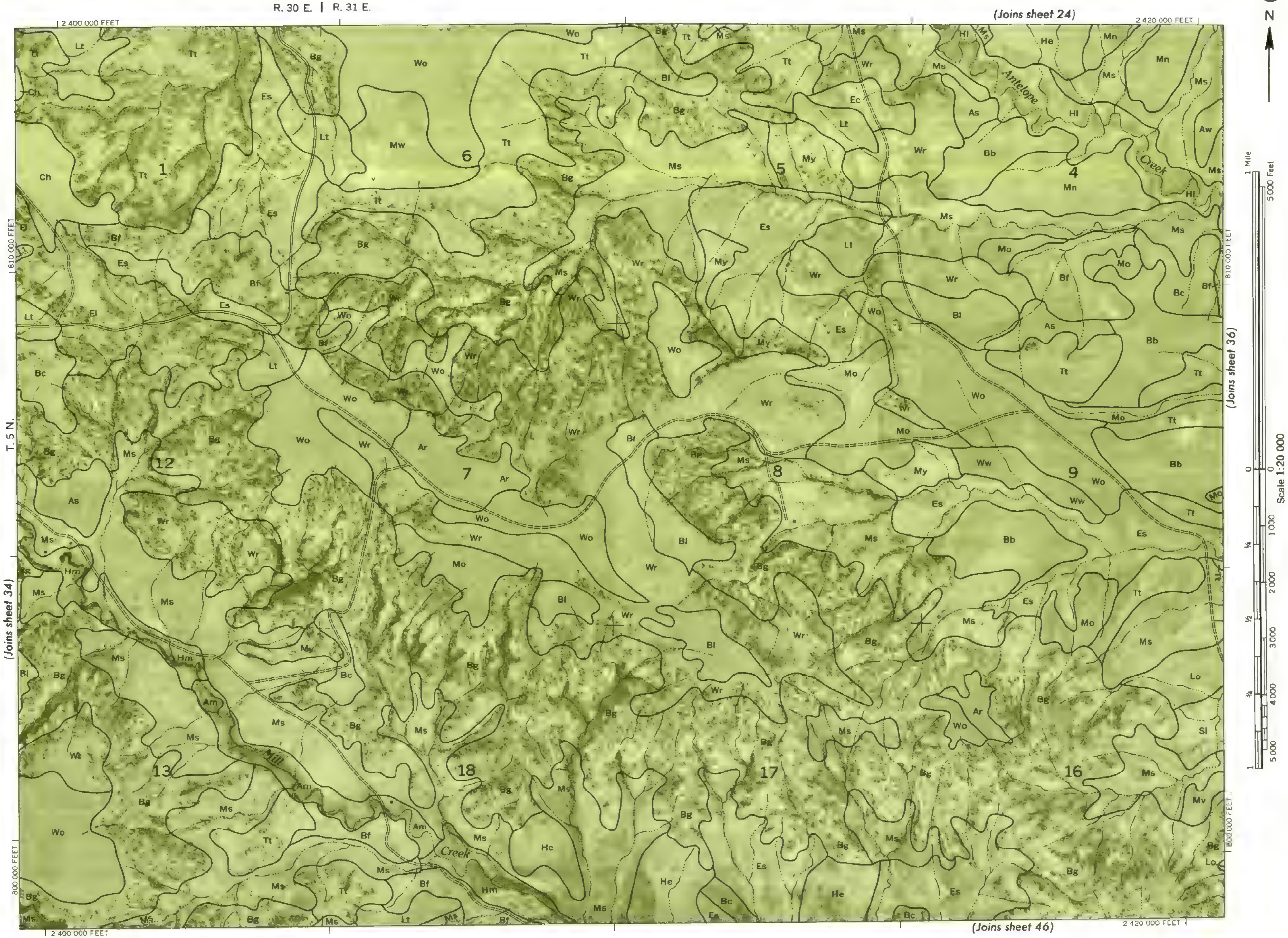


YELLOWSTONE COUNTY, MONTANA NO. 34

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 35

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 36

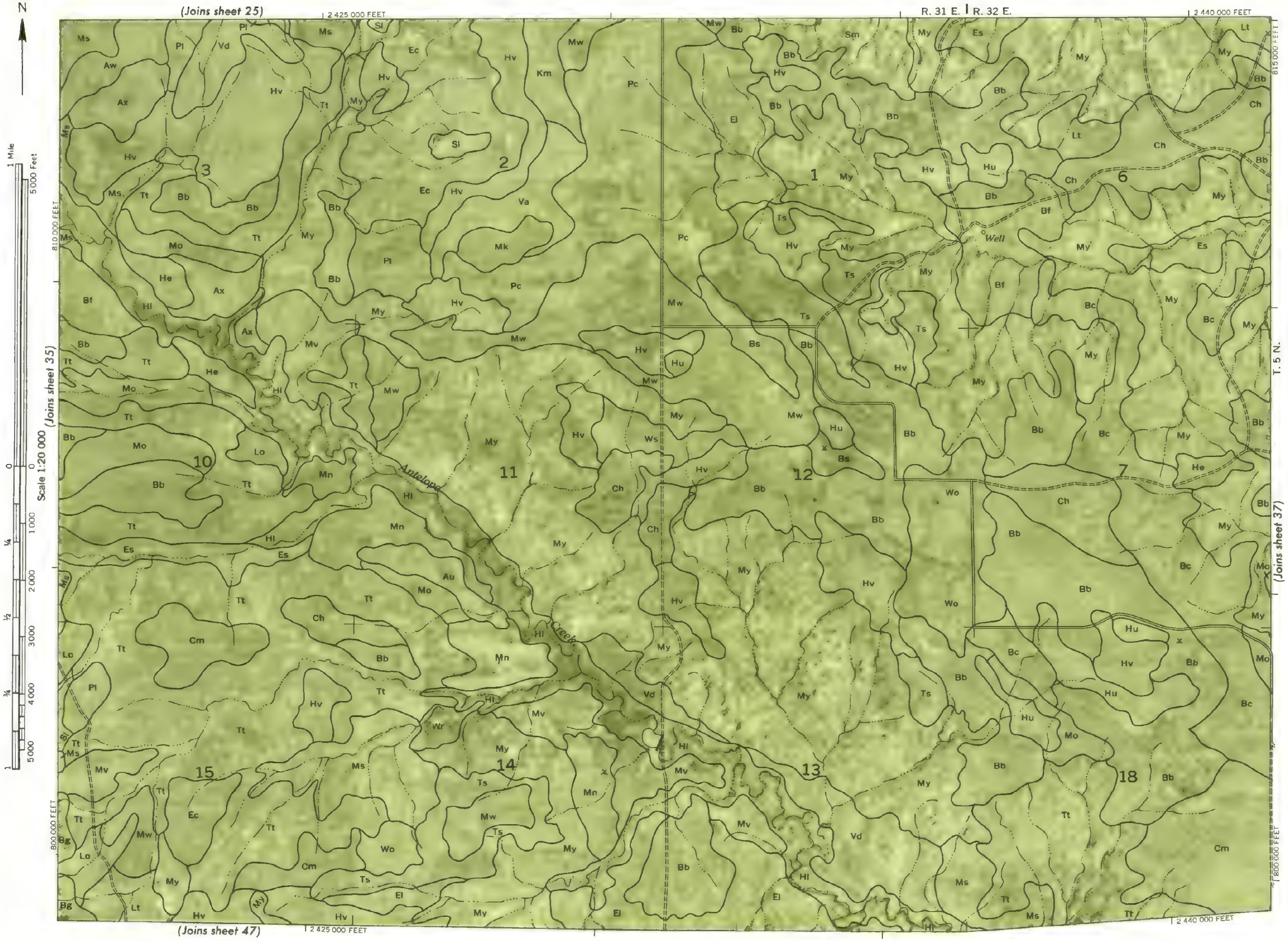
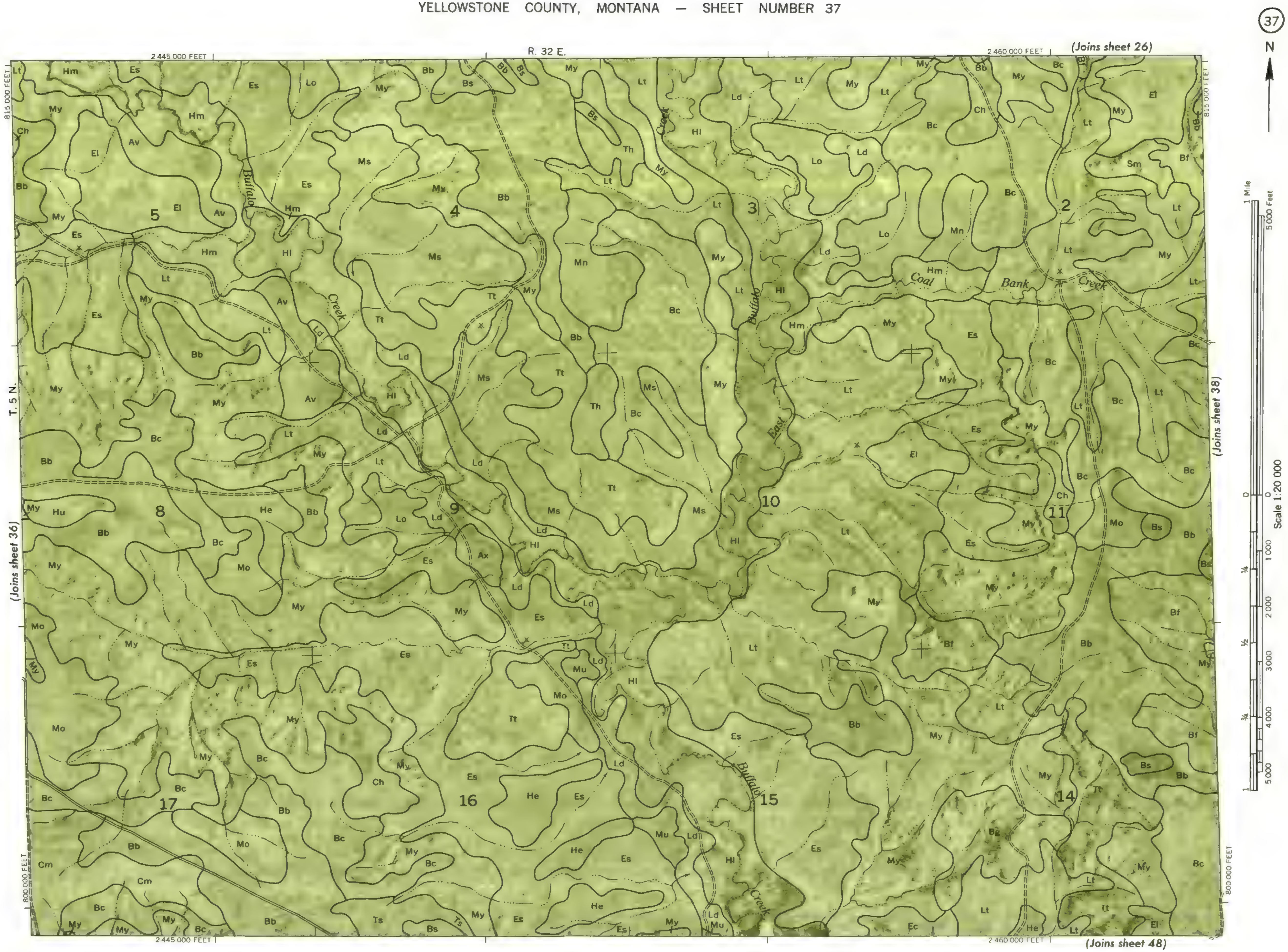


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 36

Land division corners are approximately positioned on this map.

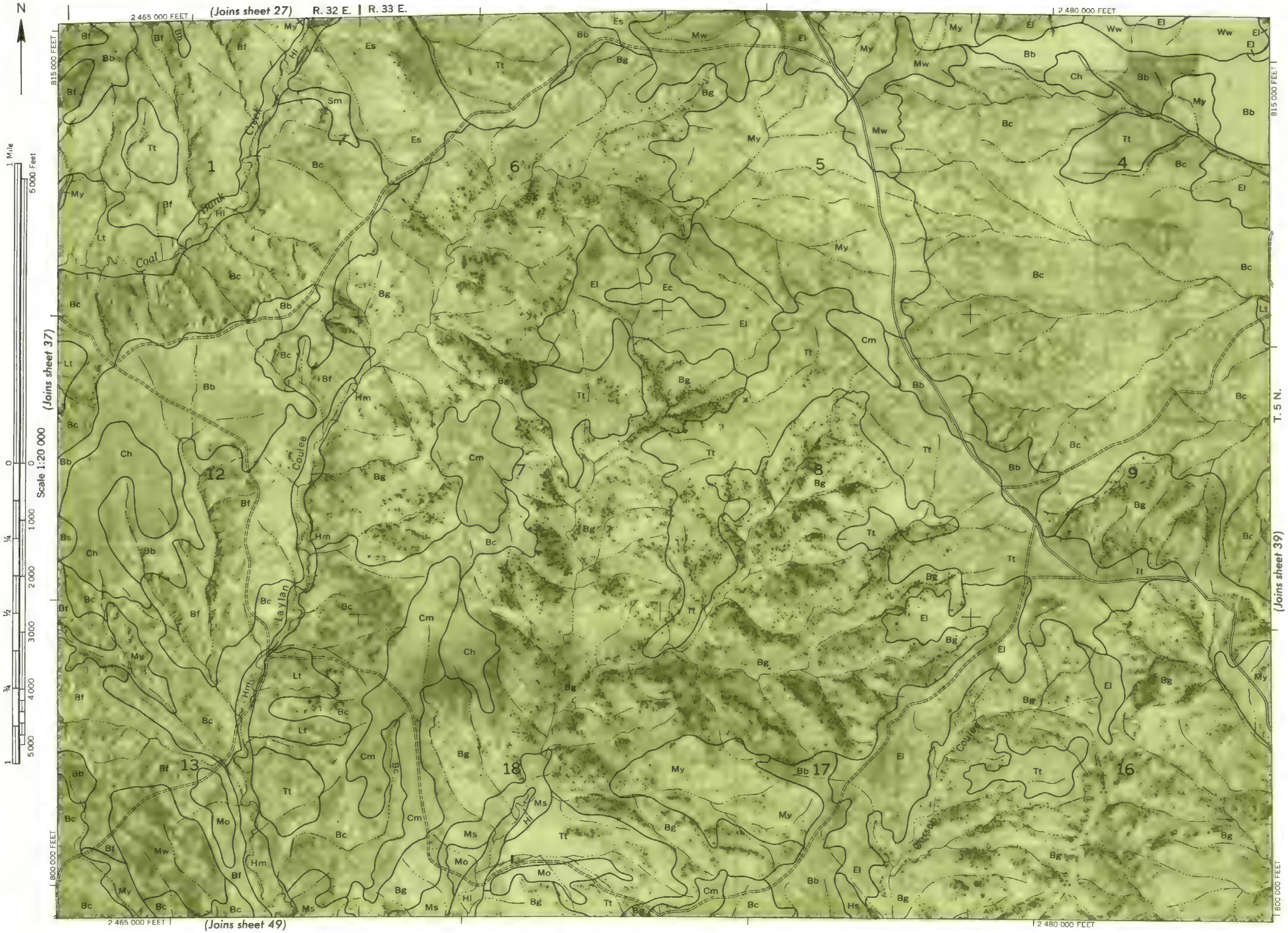
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 37

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



YELLOWSTONE COUNTY, MONTANA NO. 38

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 39

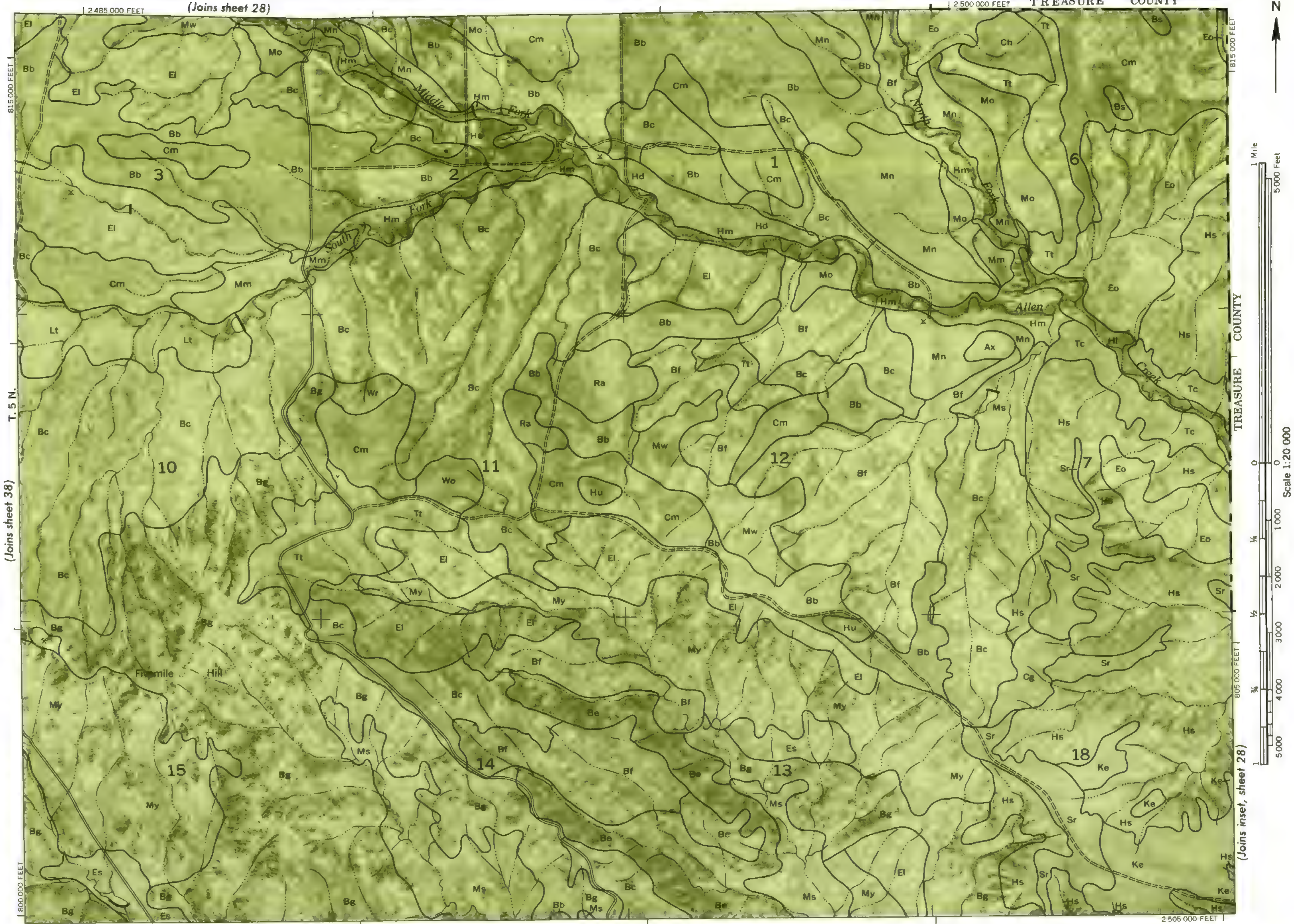


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 4

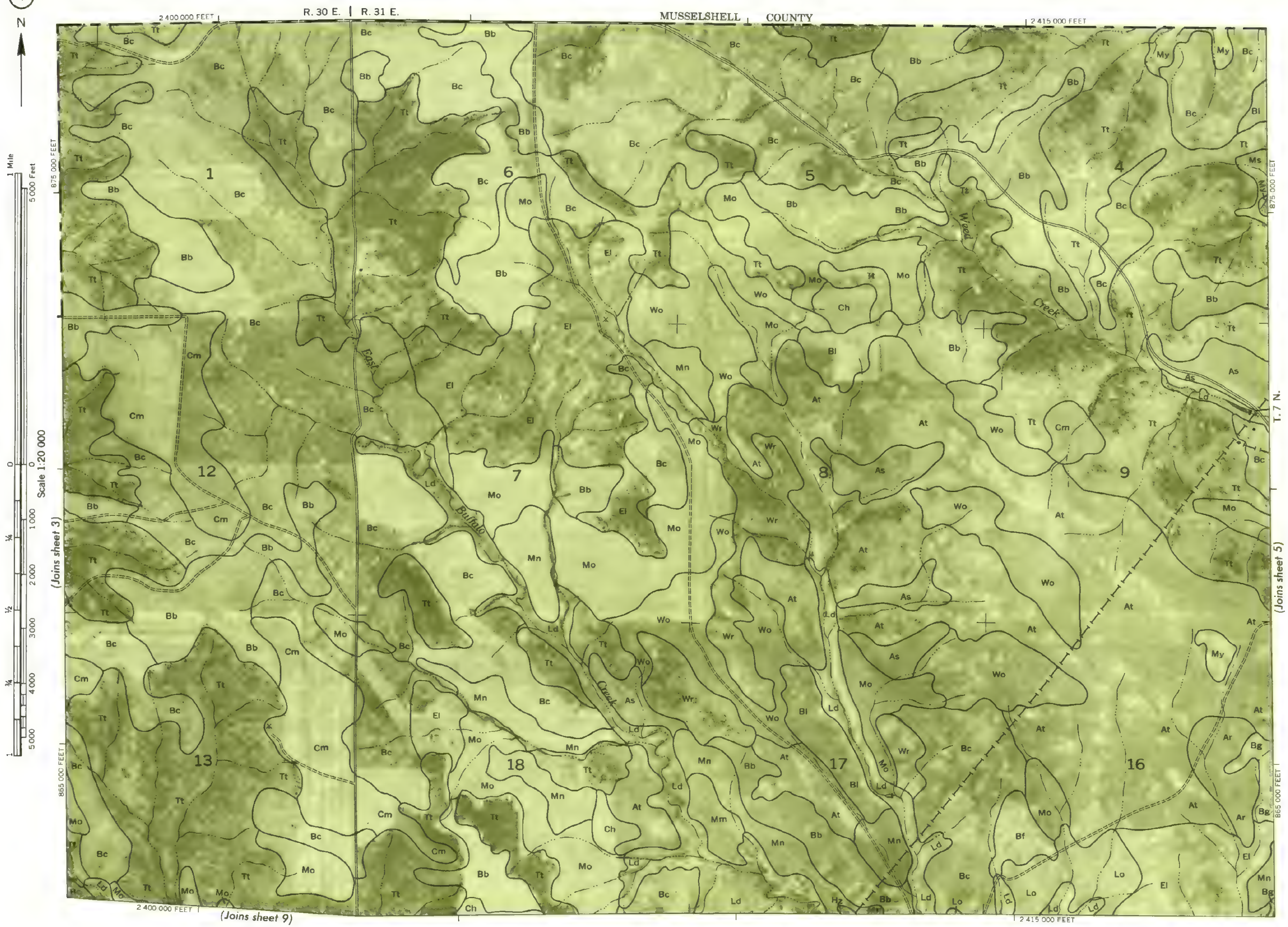


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 4

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 40

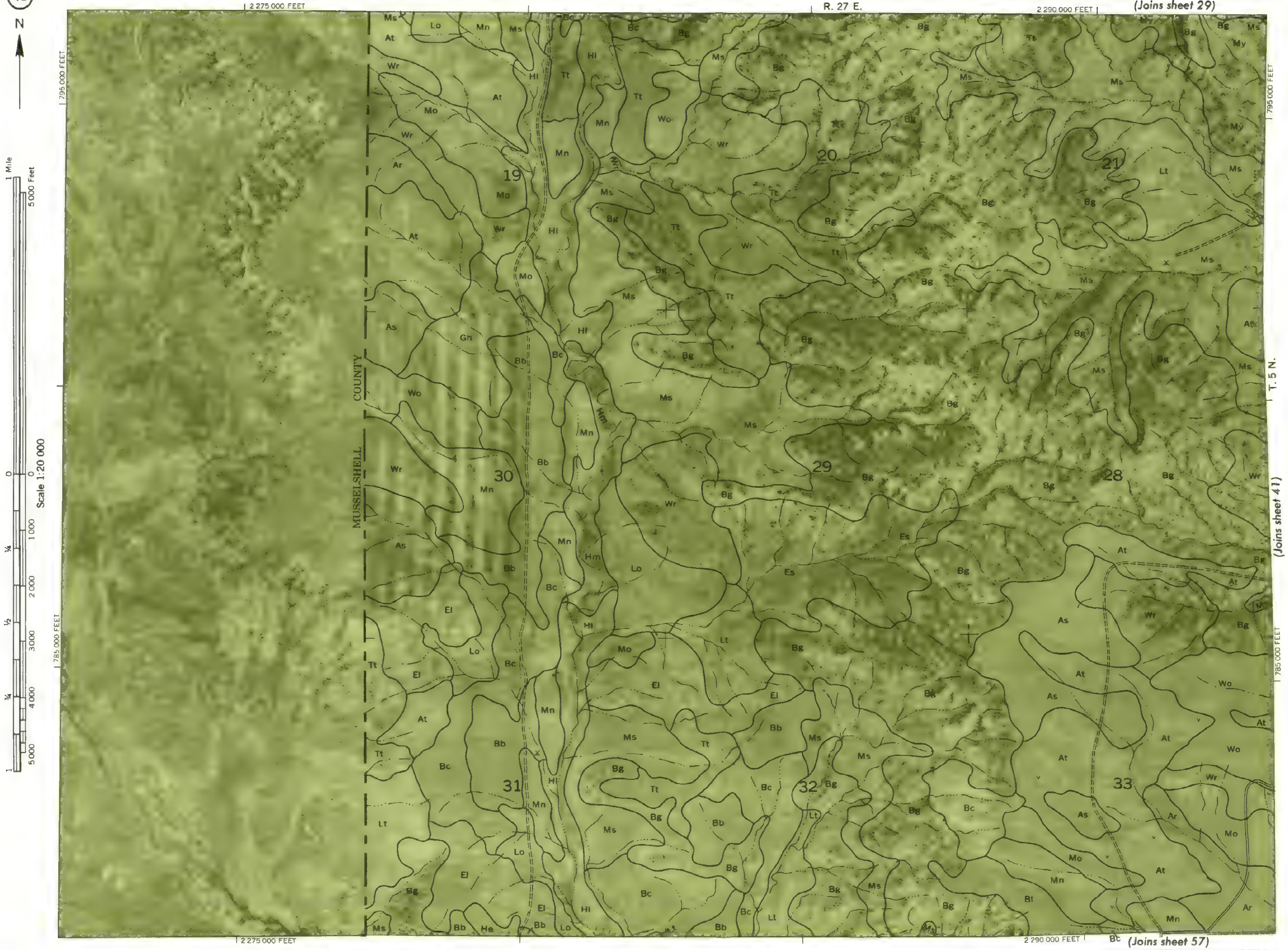


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 40

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

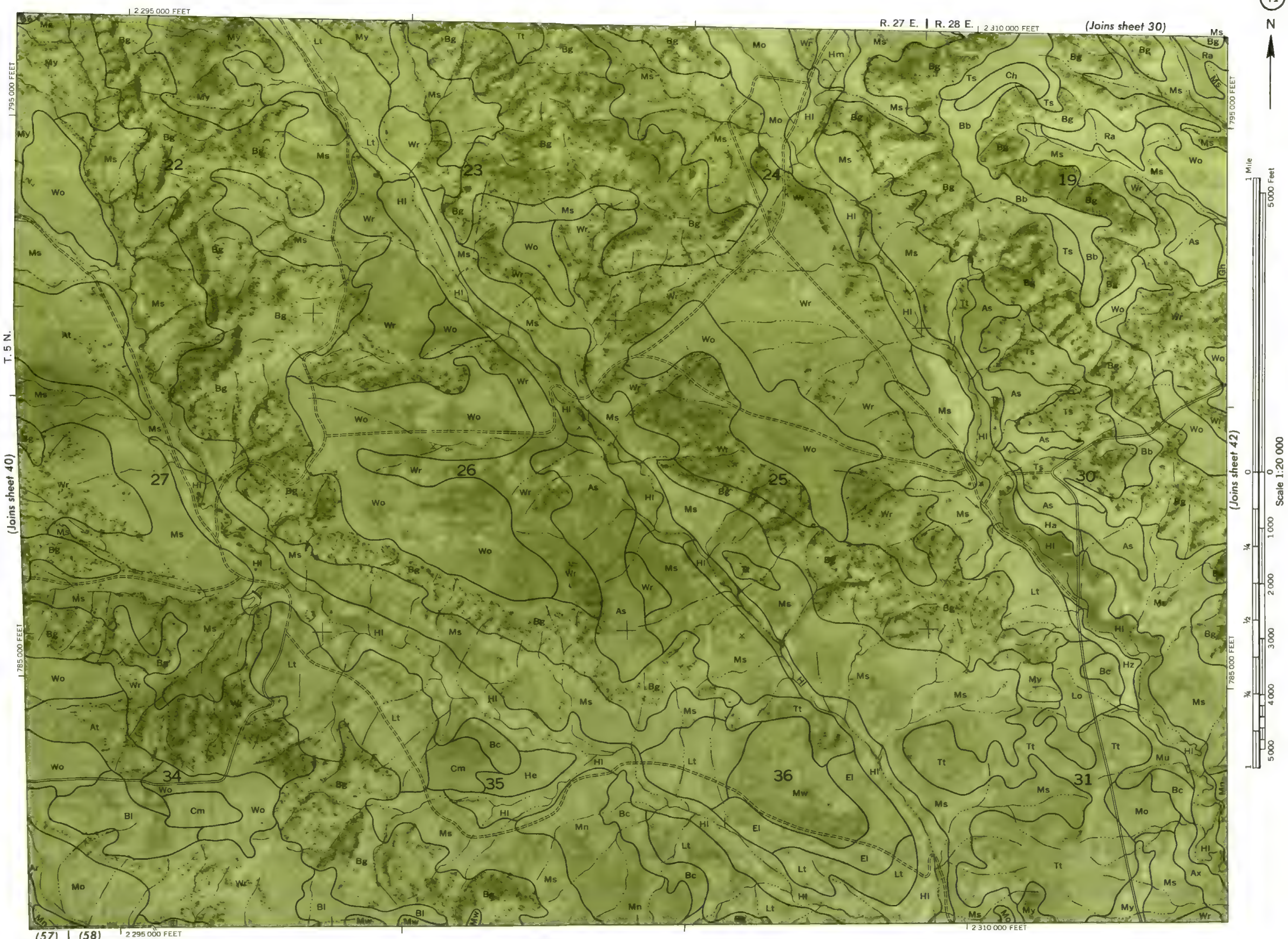


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

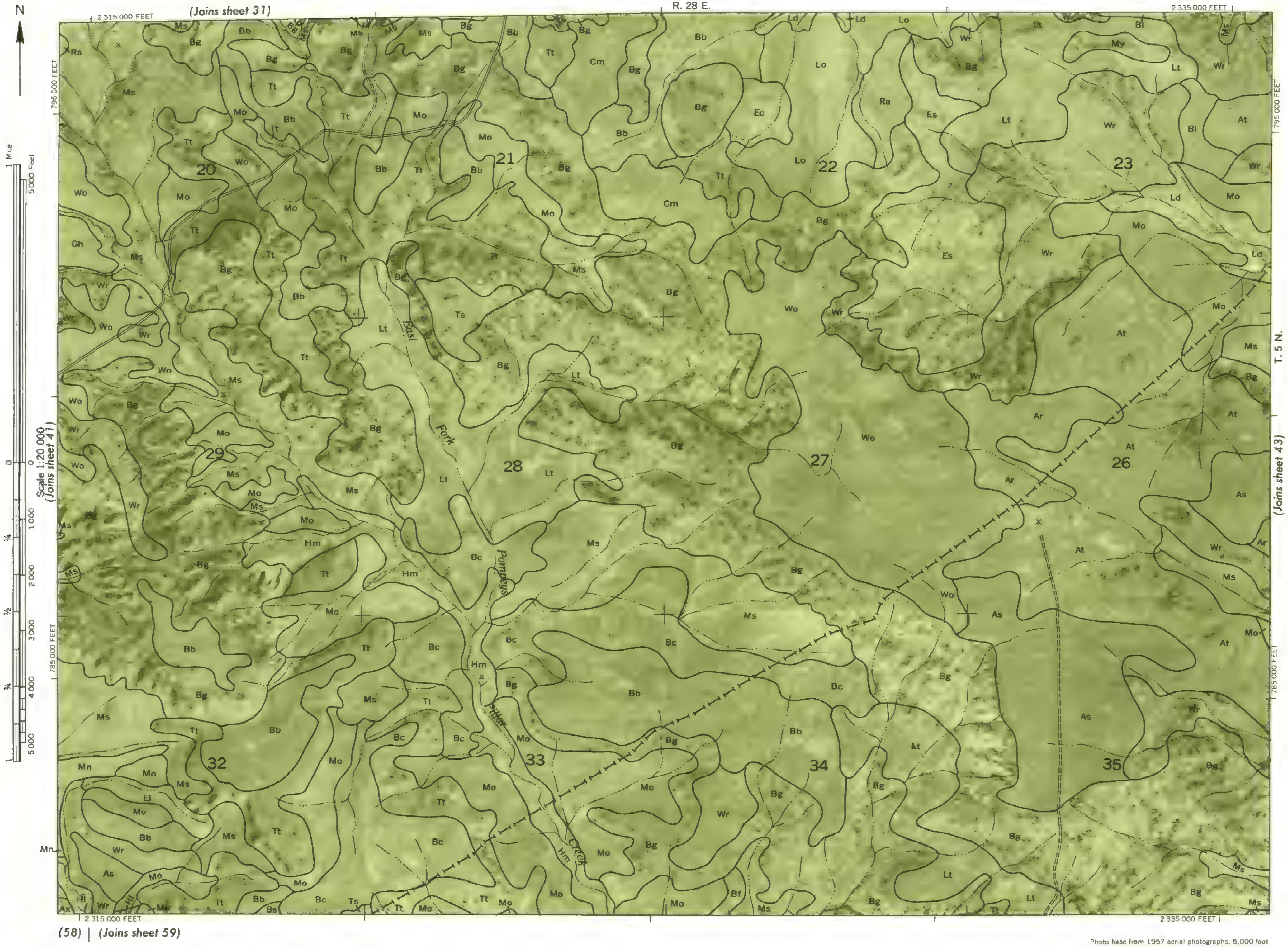


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

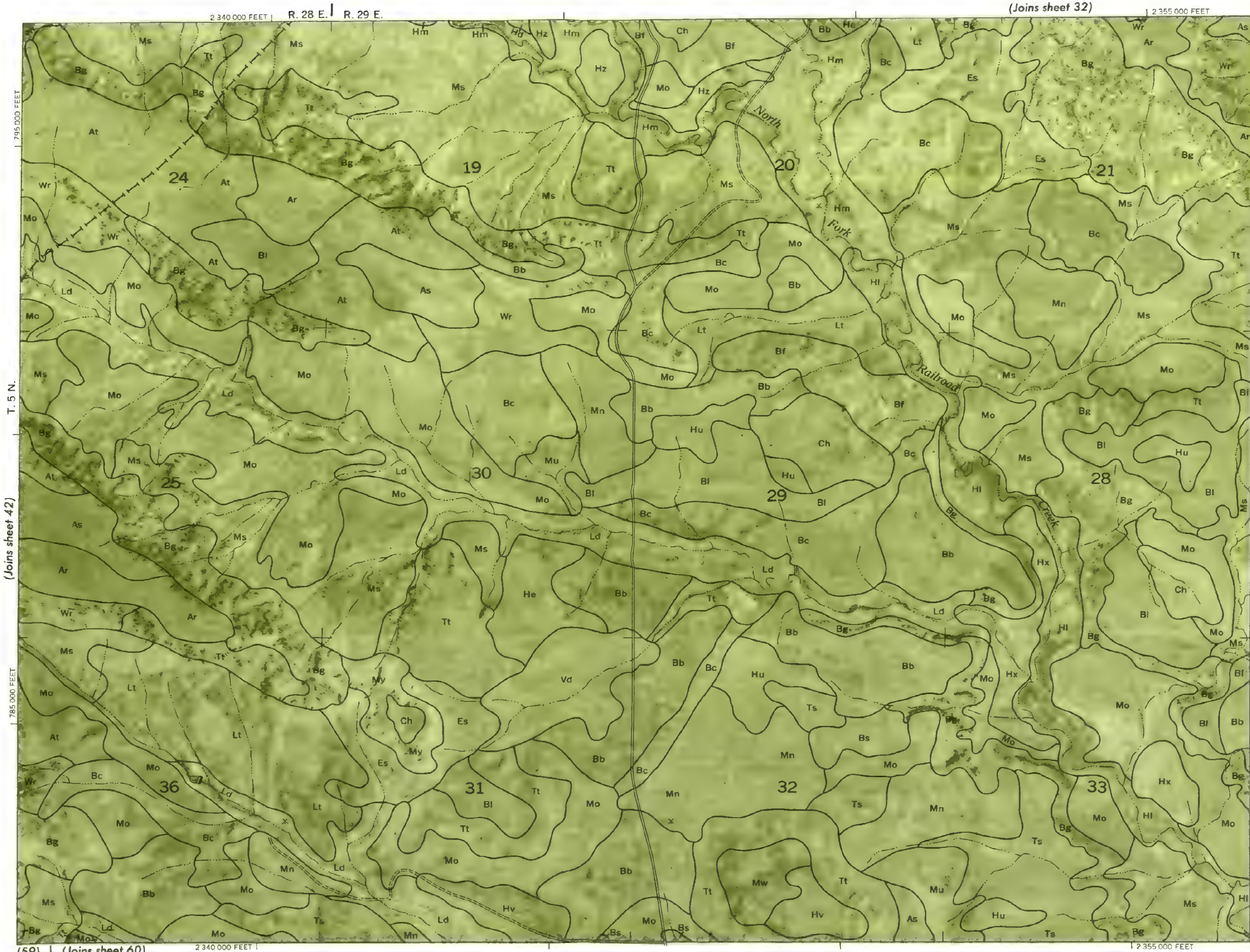
YELLOWSTONE COUNTY, MONTANA NO. 42

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

43

N



1 Mile
0
5000 Feet
Scale 1:20 000
0
1000
2000
3000
4000
5000
0
¼
½
¾
1

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 43

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 44

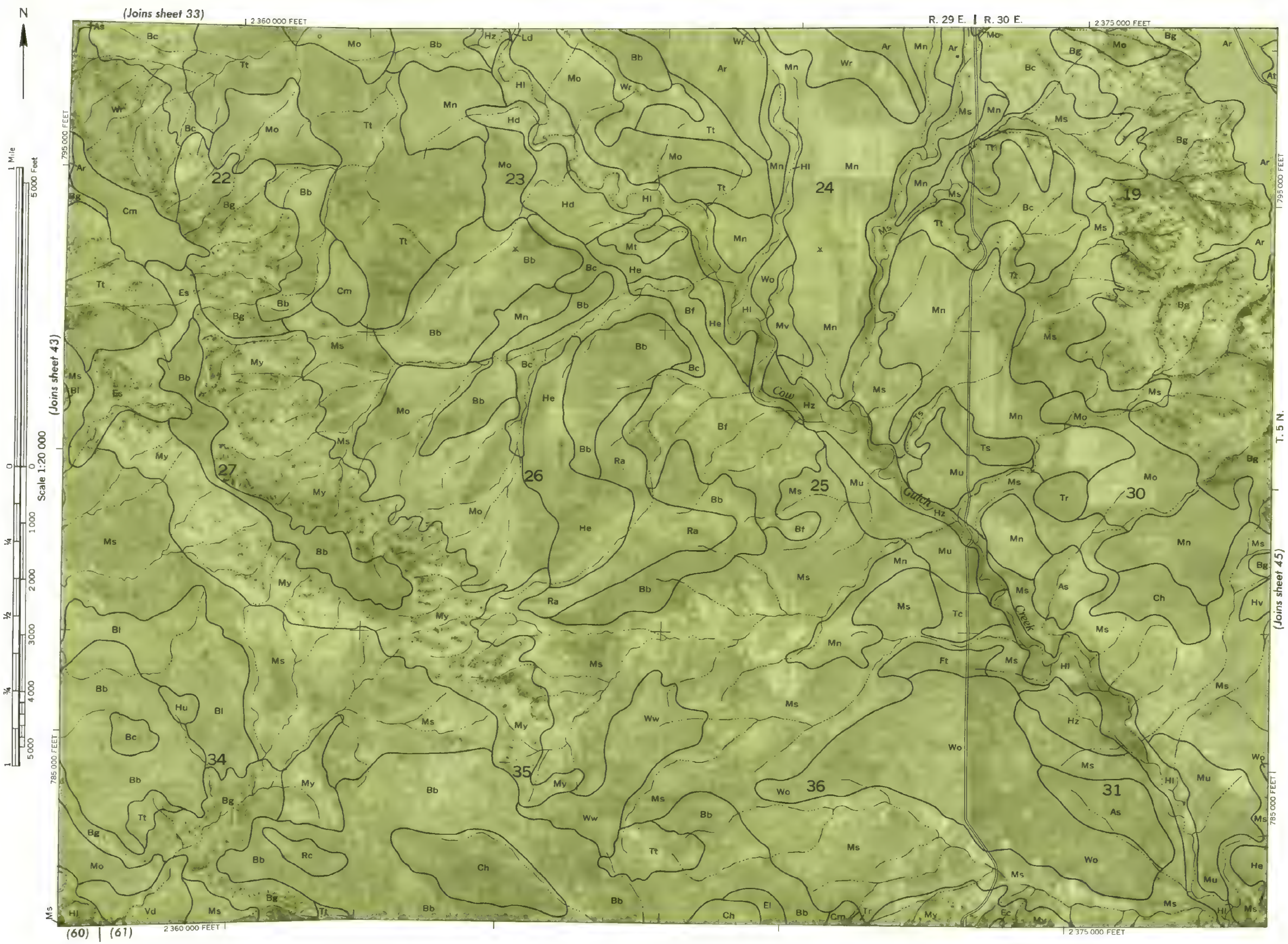


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 44

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

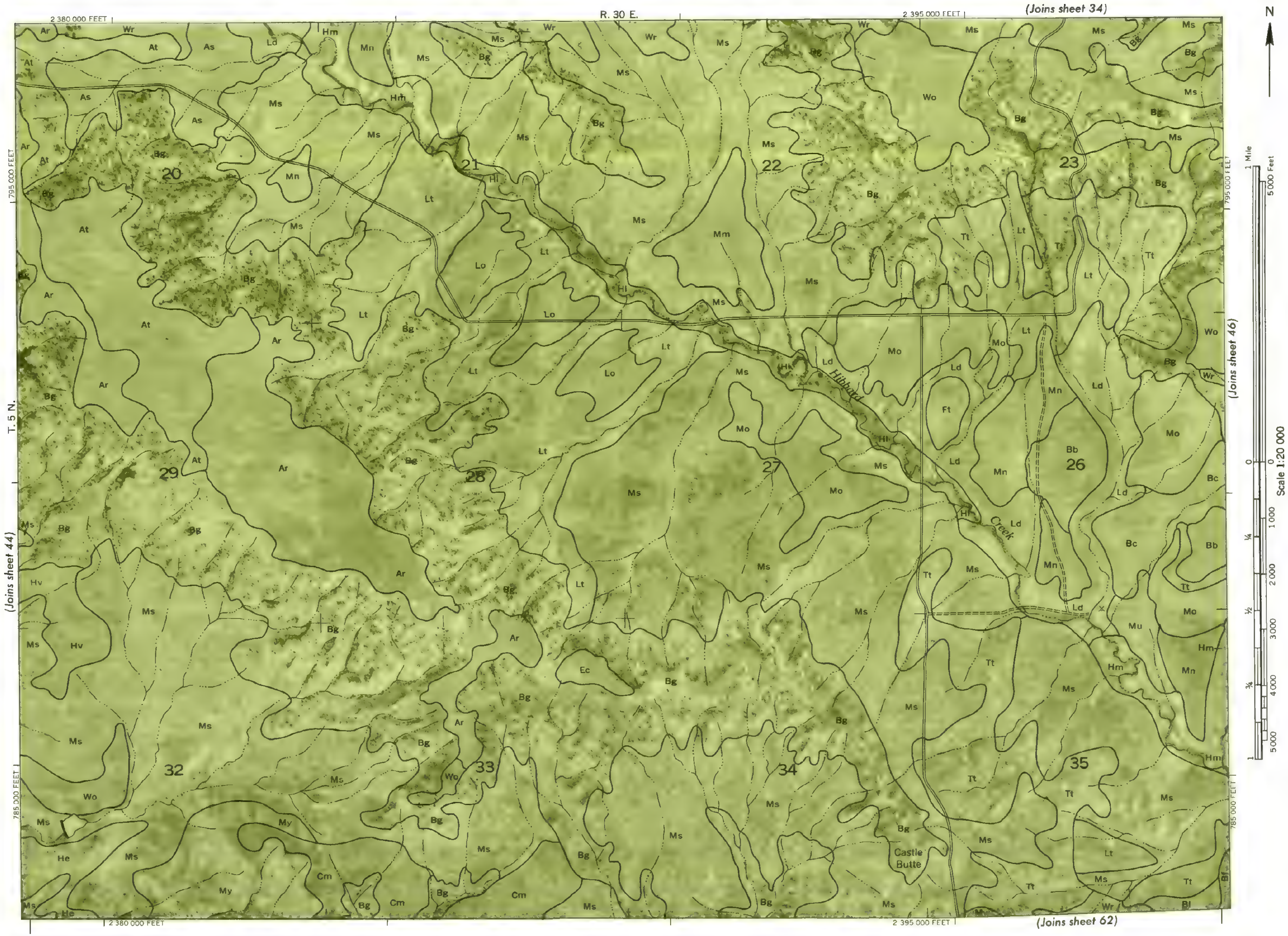


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 45

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 46

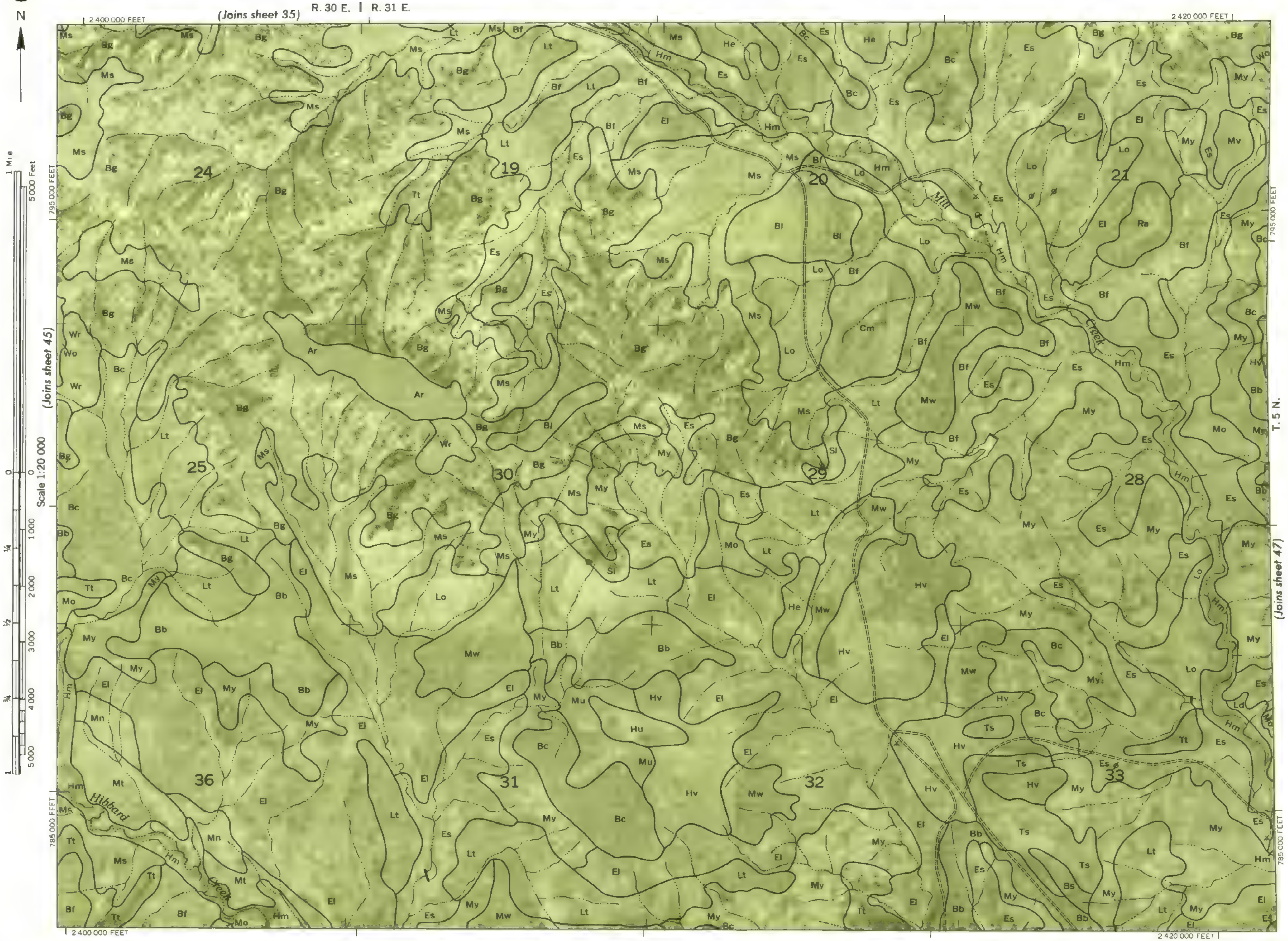


Photo base from 1957 aerial photographs. 5 000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 46

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

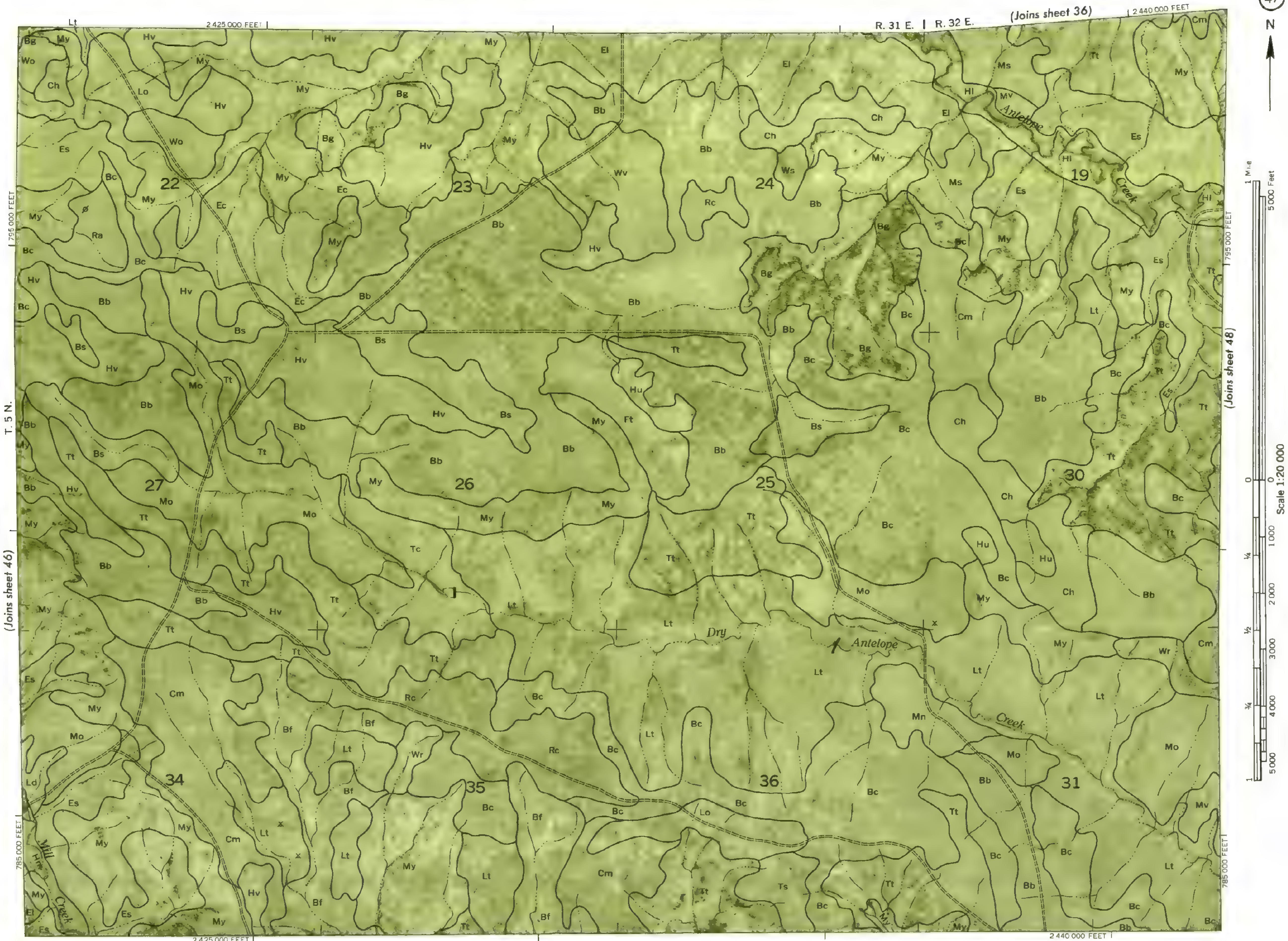


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 47

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 48

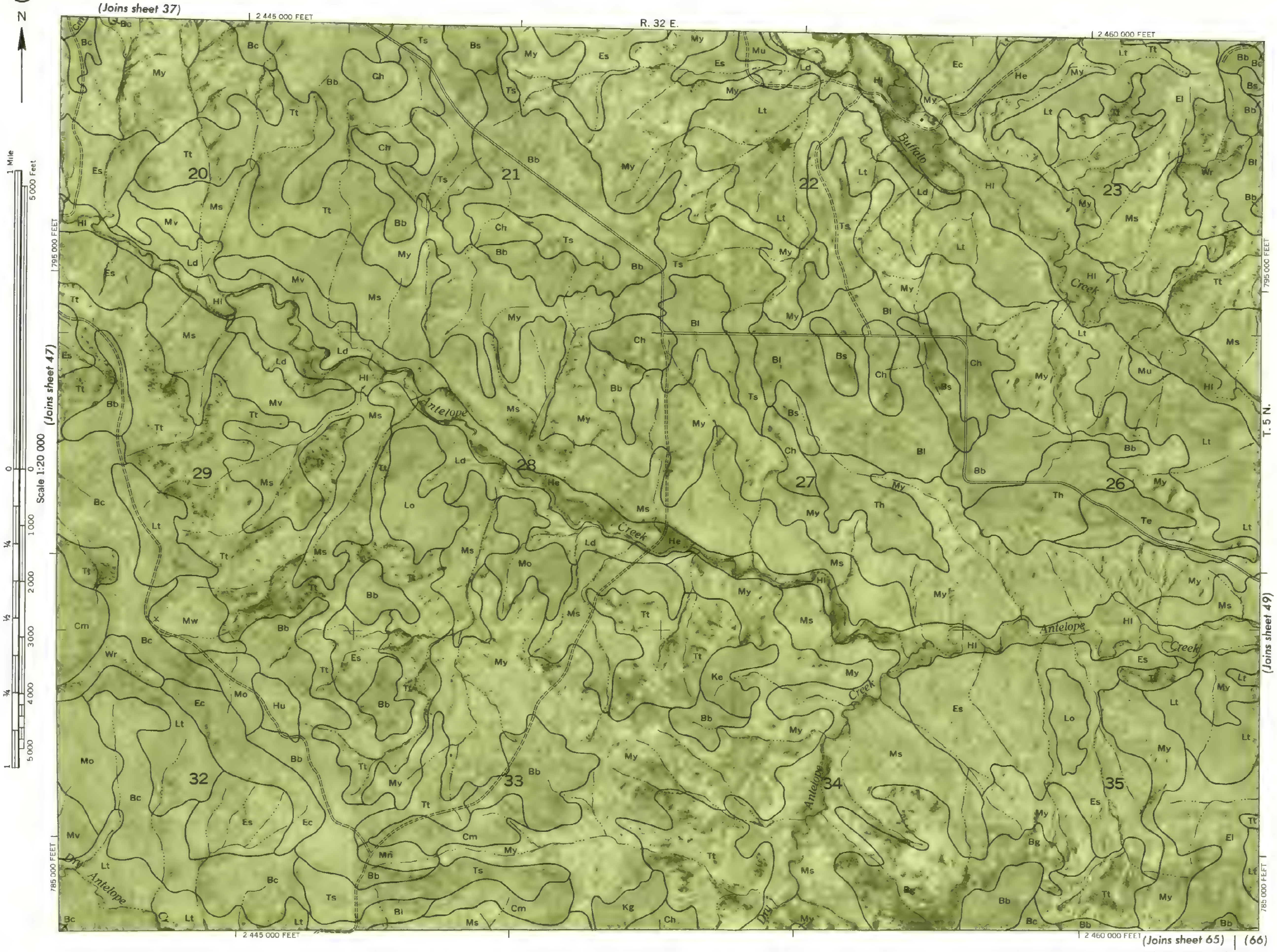


Photo base from 1957 aerial photographs. 5 000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 48

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 49

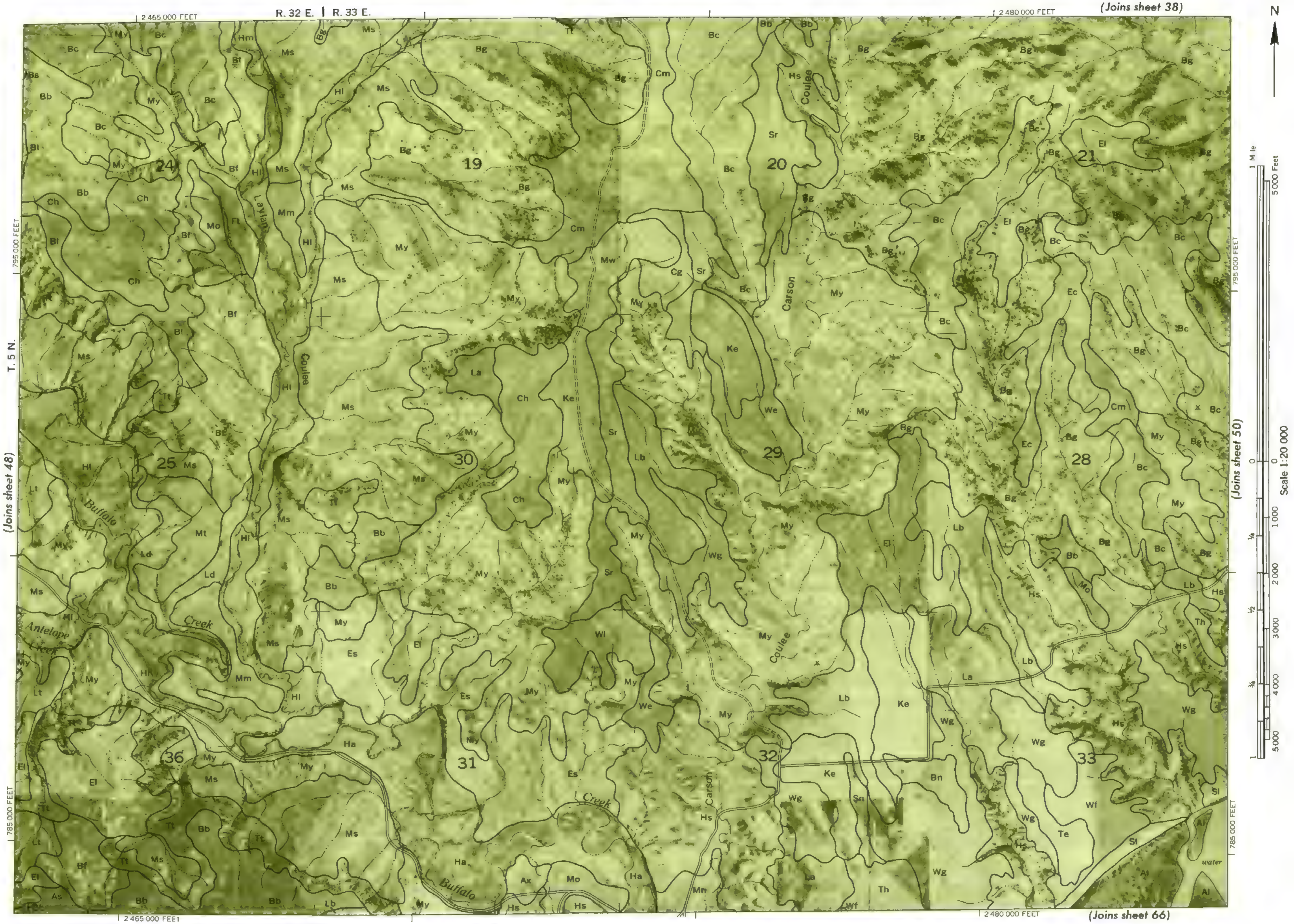


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 5

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 50

(Joins sheet 39)

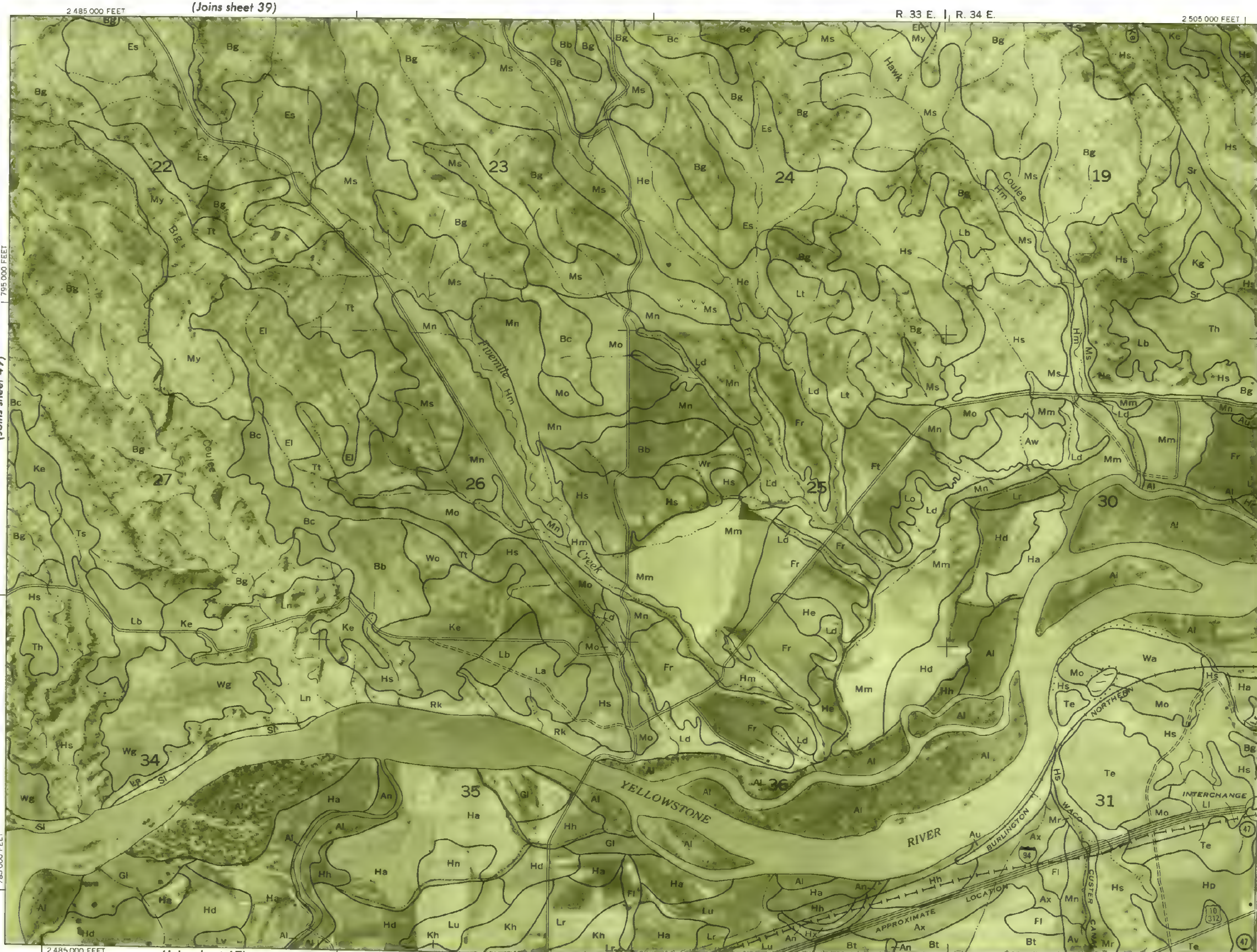


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 50

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station. Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 51

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 52

YELLOWSTONE COUNTY, MONTANA NO. 52

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA NO. 53

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 54

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 54

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

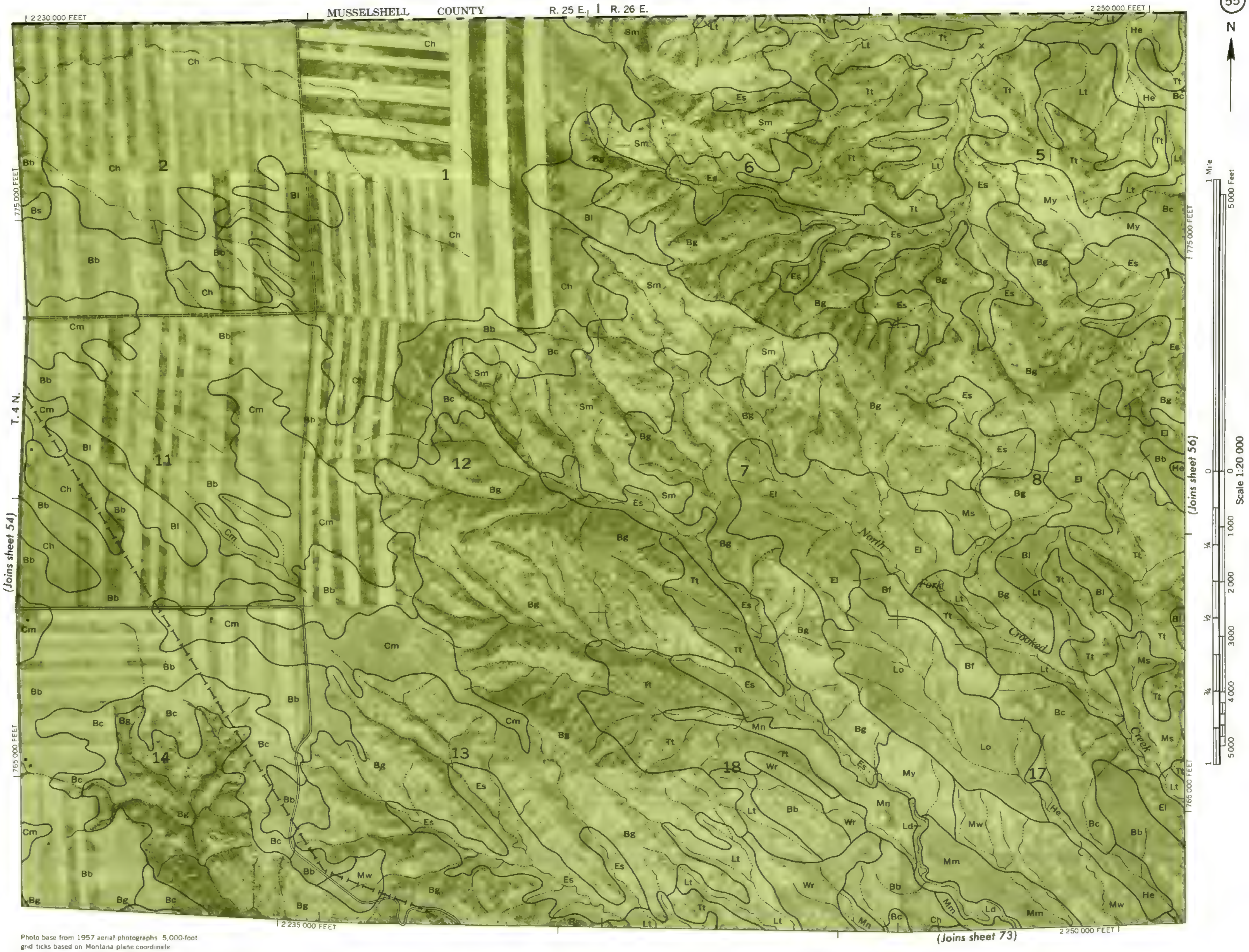


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

56

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 56

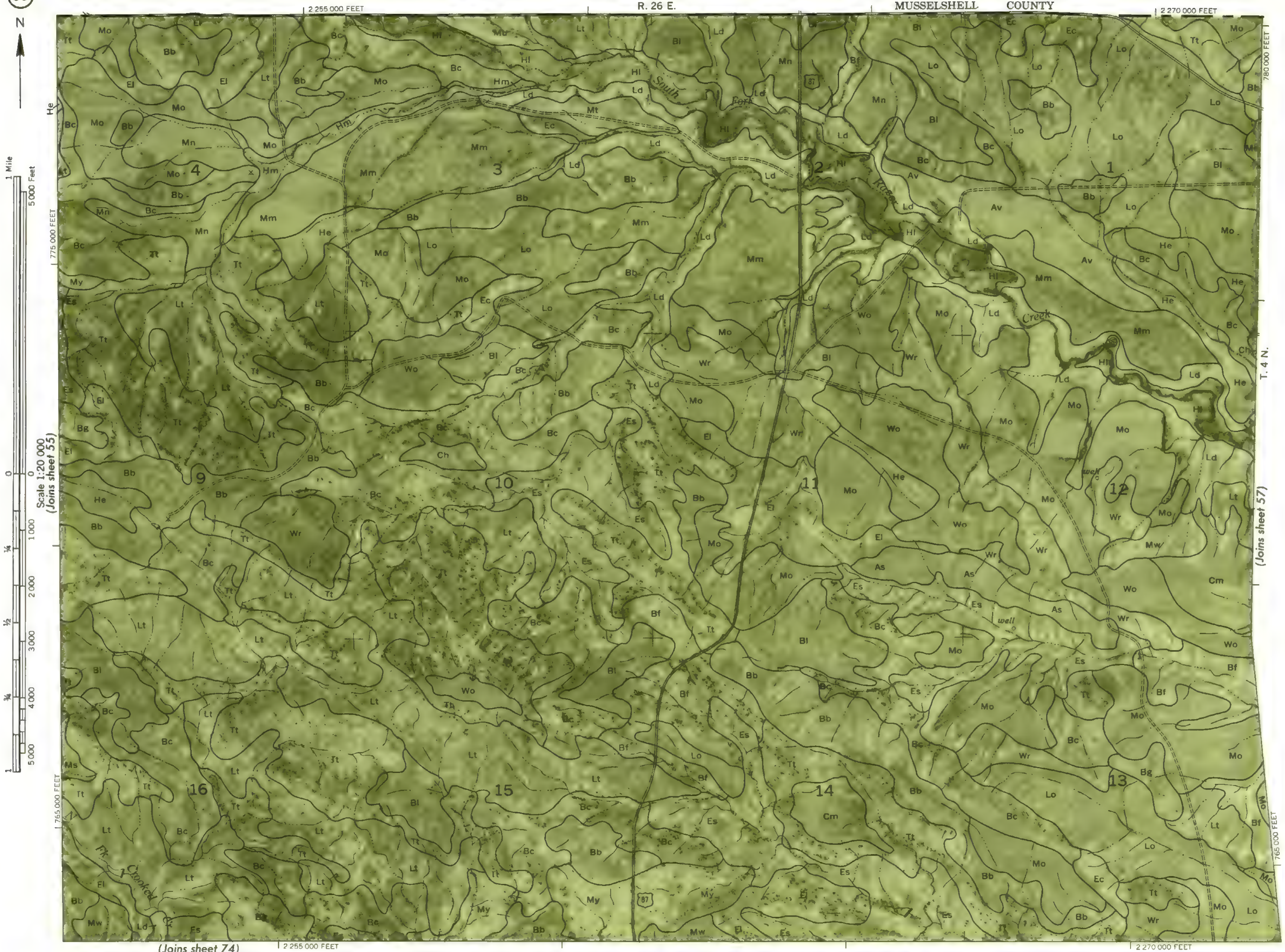
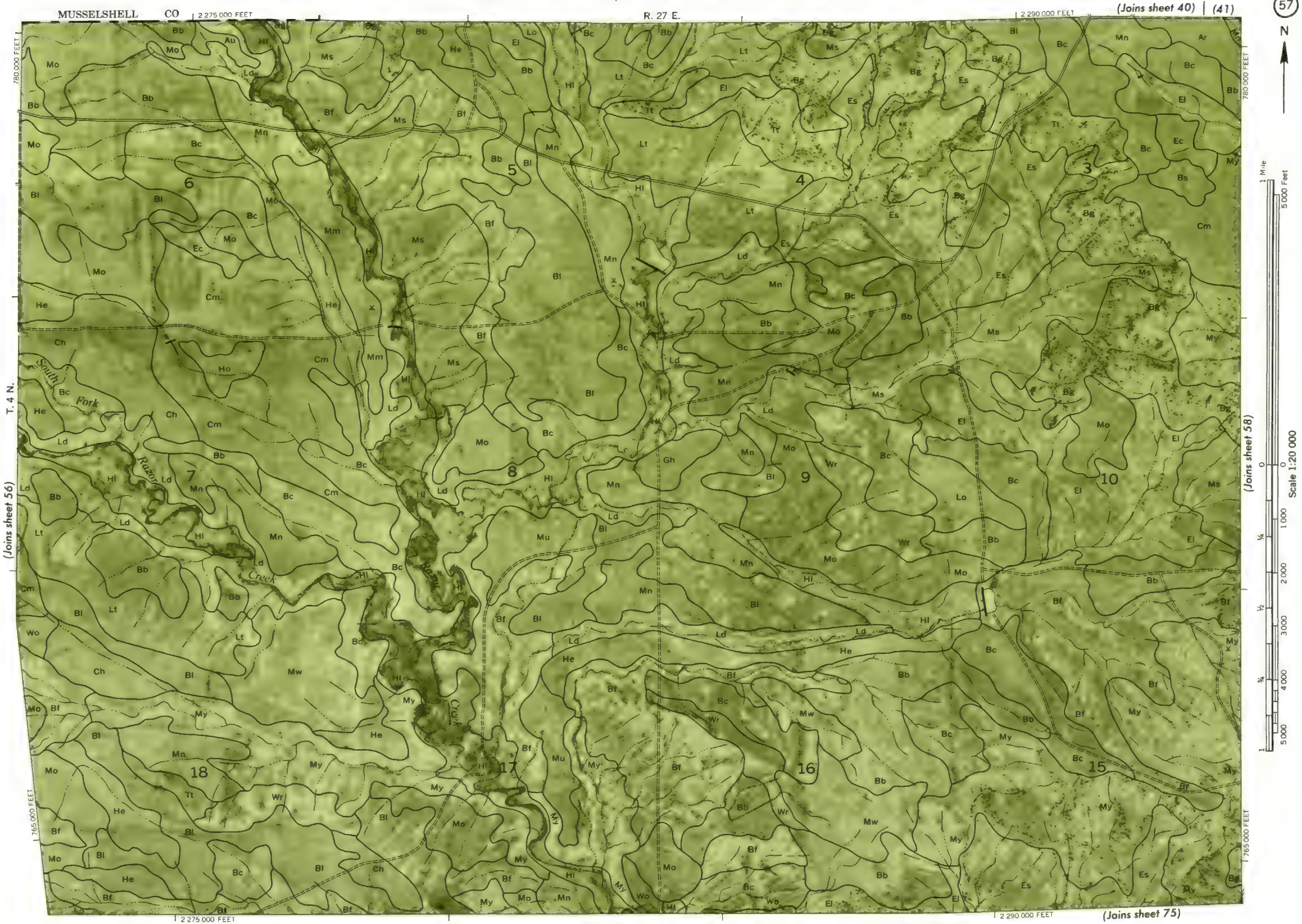


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 56

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

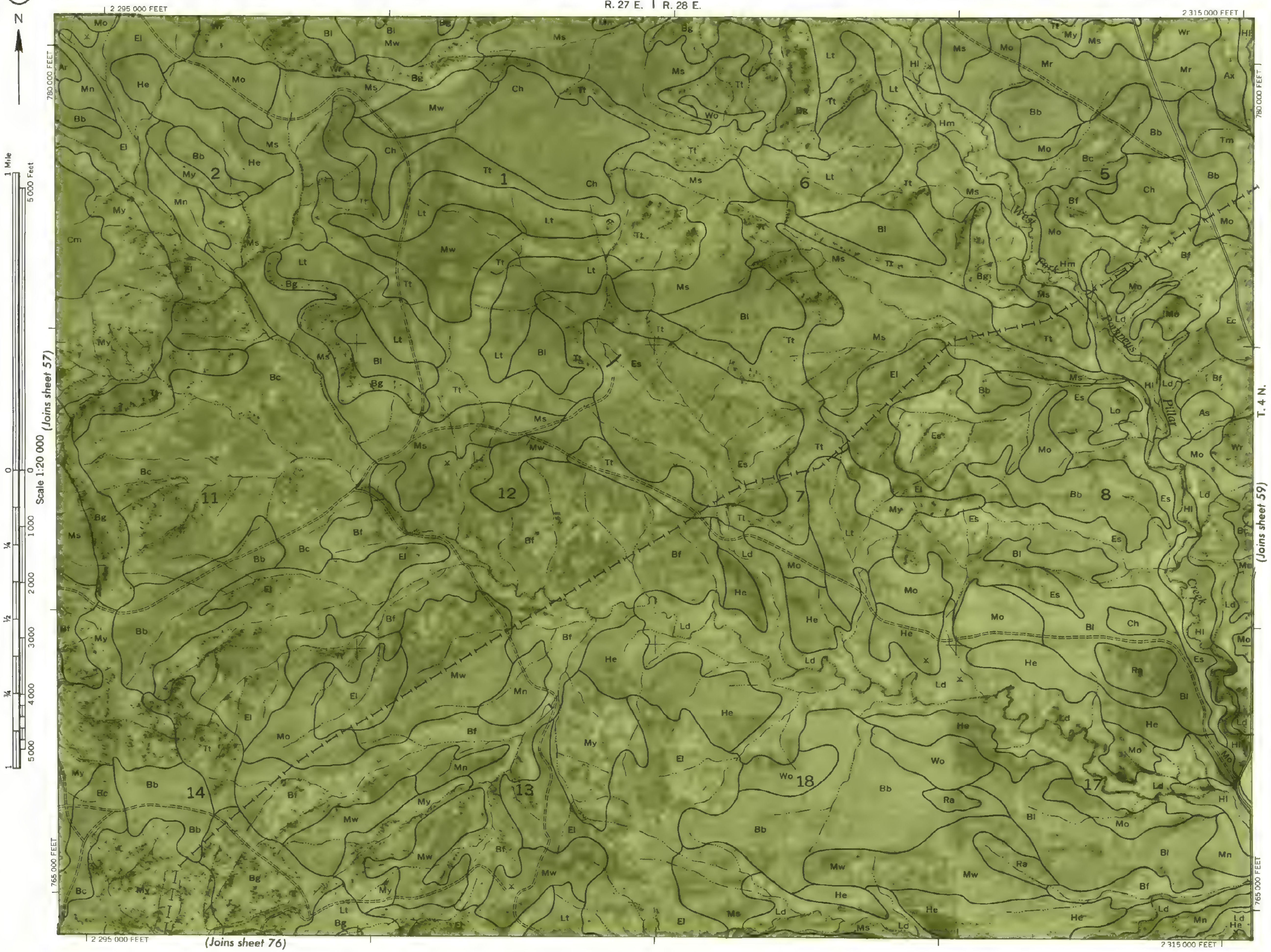
YELLOWSTONE COUNTY, MONTANA NO. 57

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 58

(Joins sheet 41) | (42)

R. 27 E. | R. 28 E.



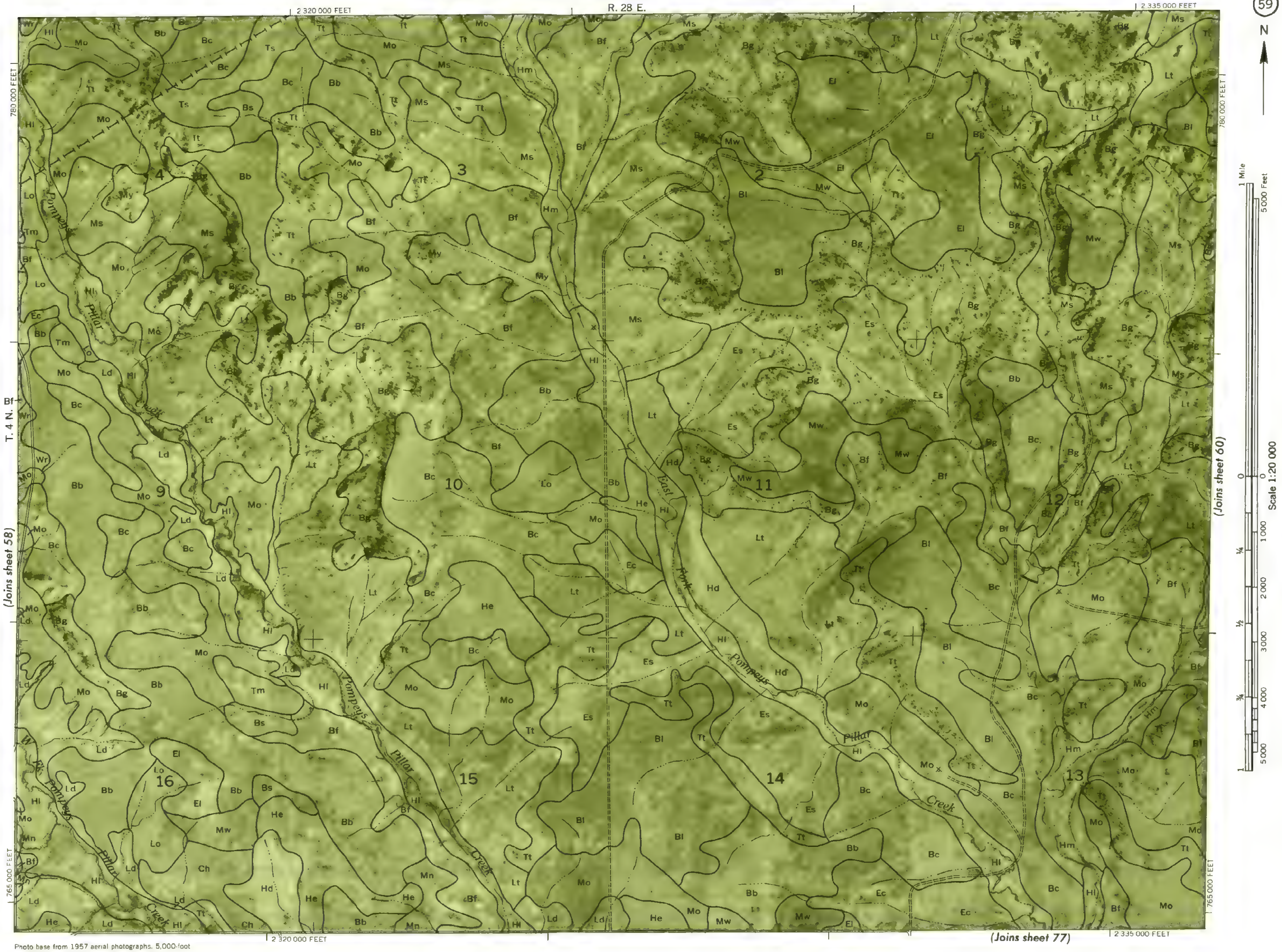
YELLOWSTONE COUNTY, MONTANA NO. 58

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

(Joins sheet 42) | (43)



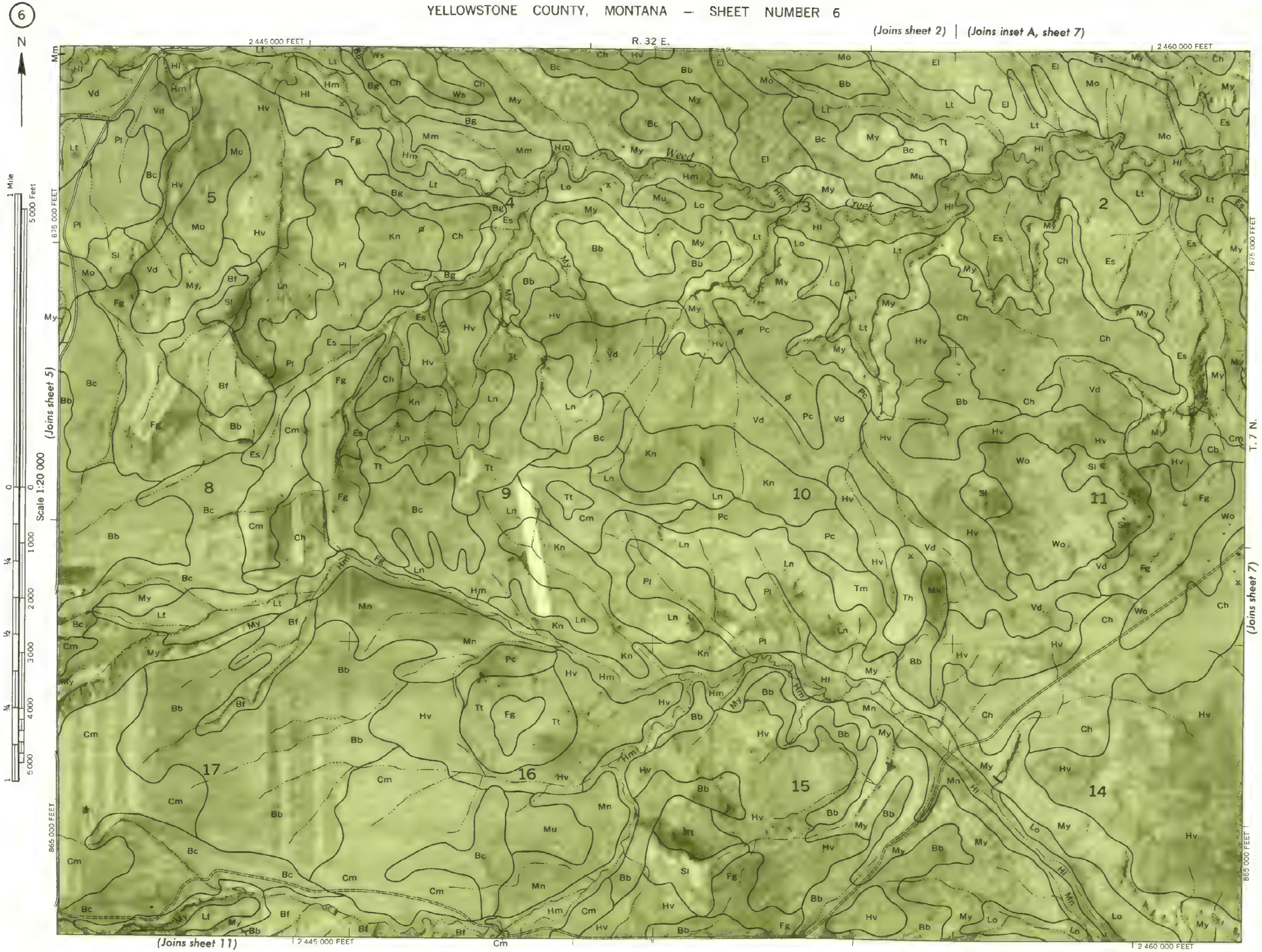
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 59

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 6



YELLOWSTONE COUNTY, MONTANA NO. 6

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 60

(Joins sheet 43) | (44)

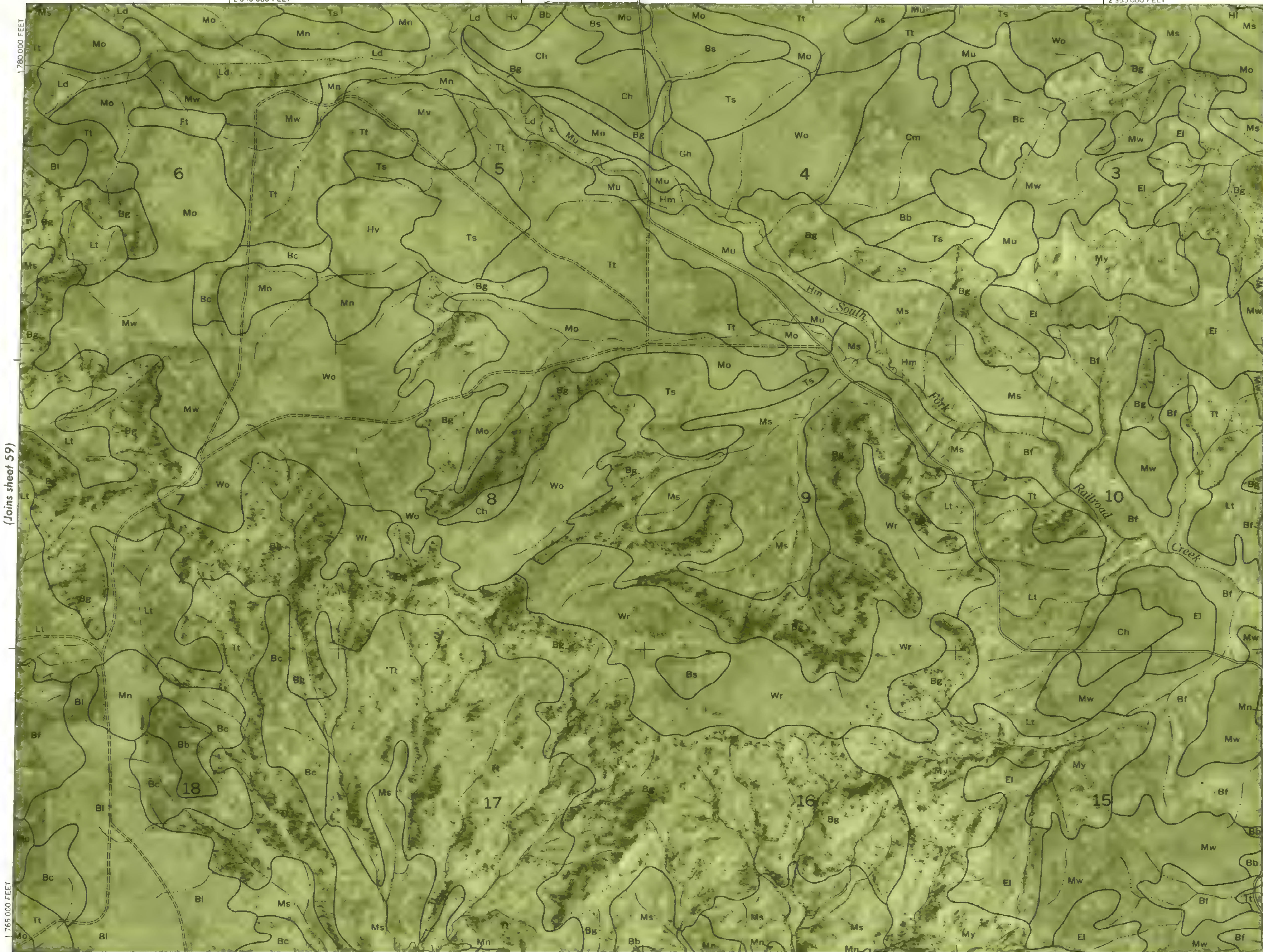
N

1 Mile

5000 Feet

Scale 1:20 000

(Joins sheet 59)



(Joins sheet 61)

(Joins sheet 78)

2 340 000 FEET

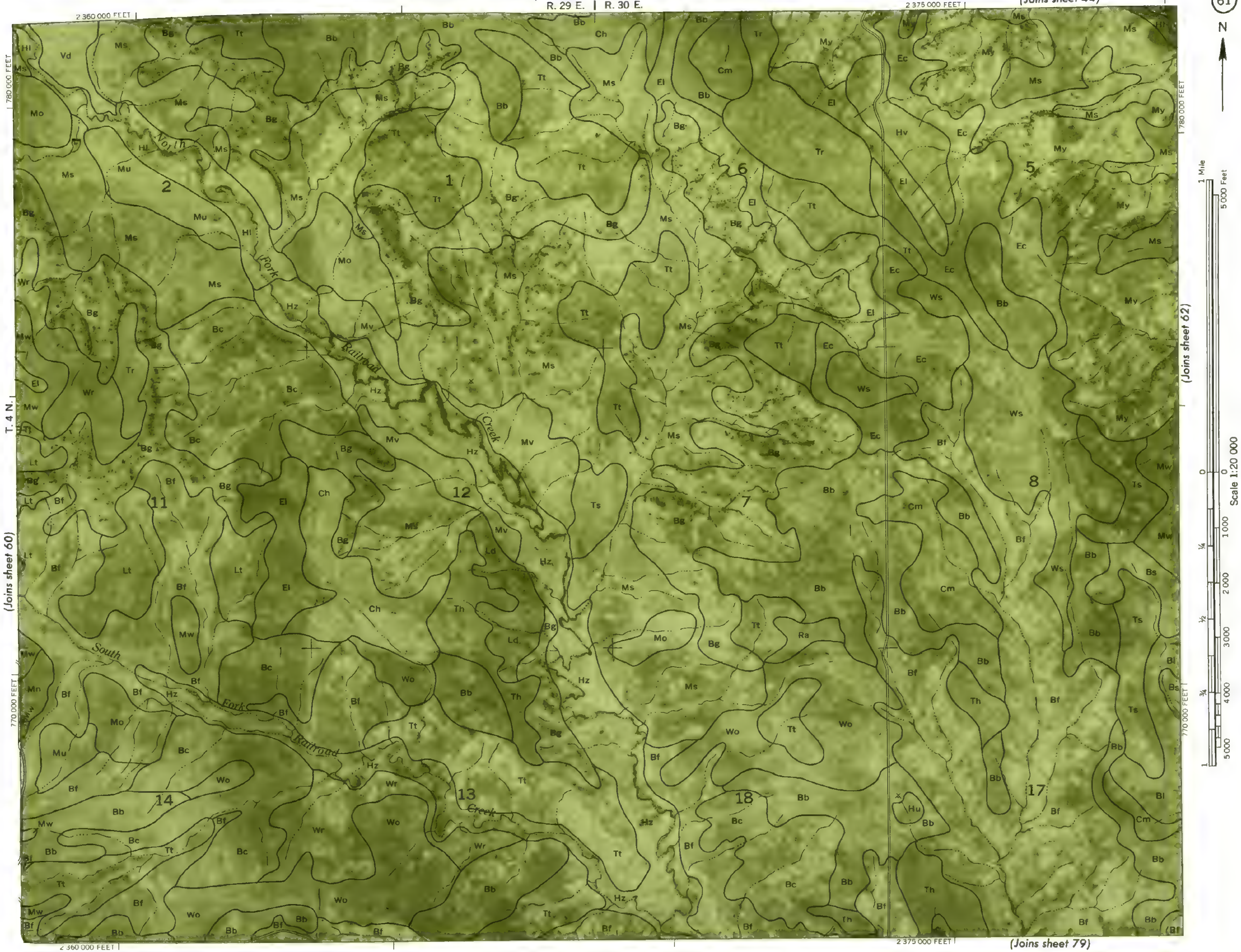
2 355 000 FEET

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 60

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

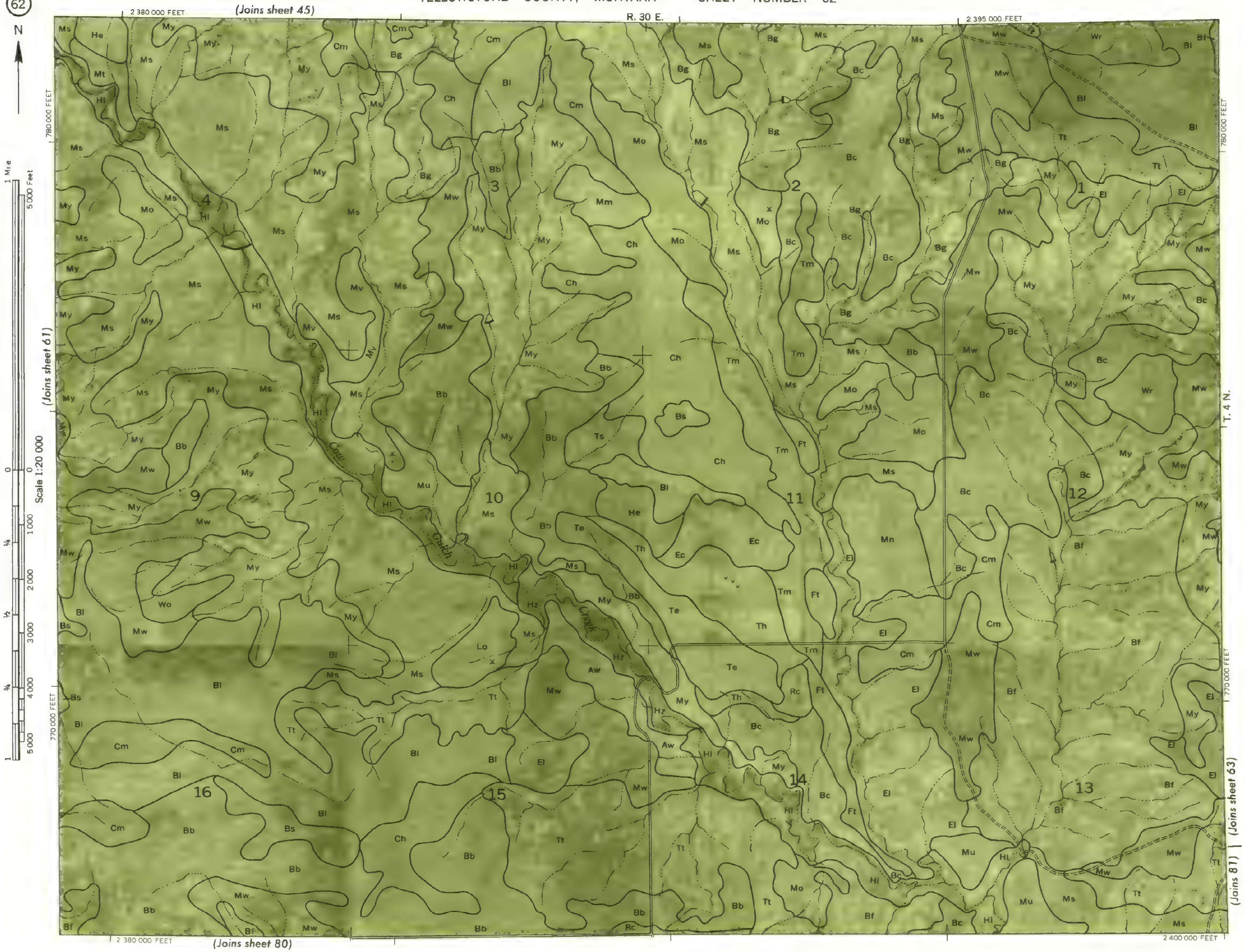


This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 61

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 62



YELLOWSTONE COUNTY, MONTANA NO. 62

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

...photographs. 5,000-foot
...lane coordinate
...th American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 63

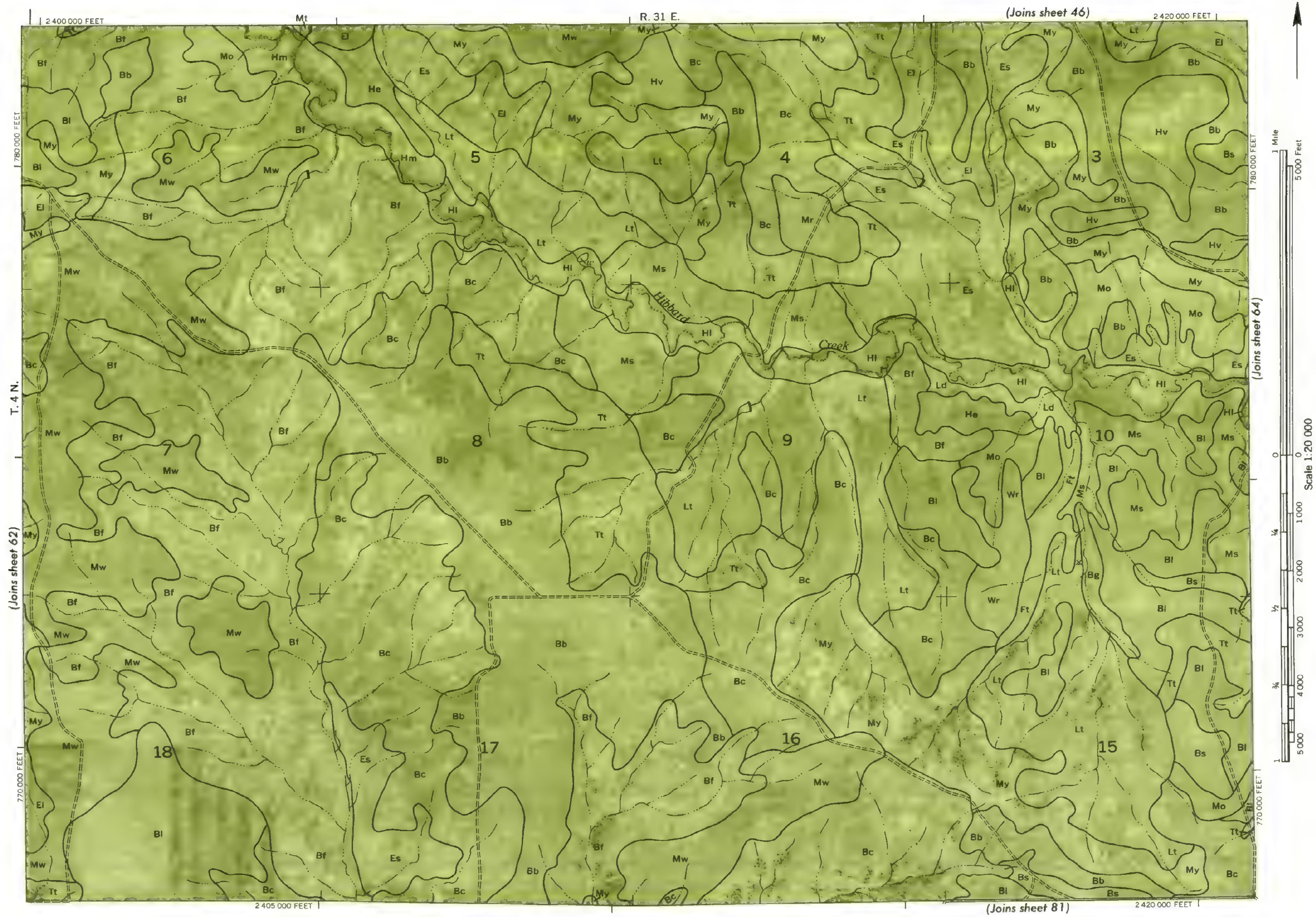
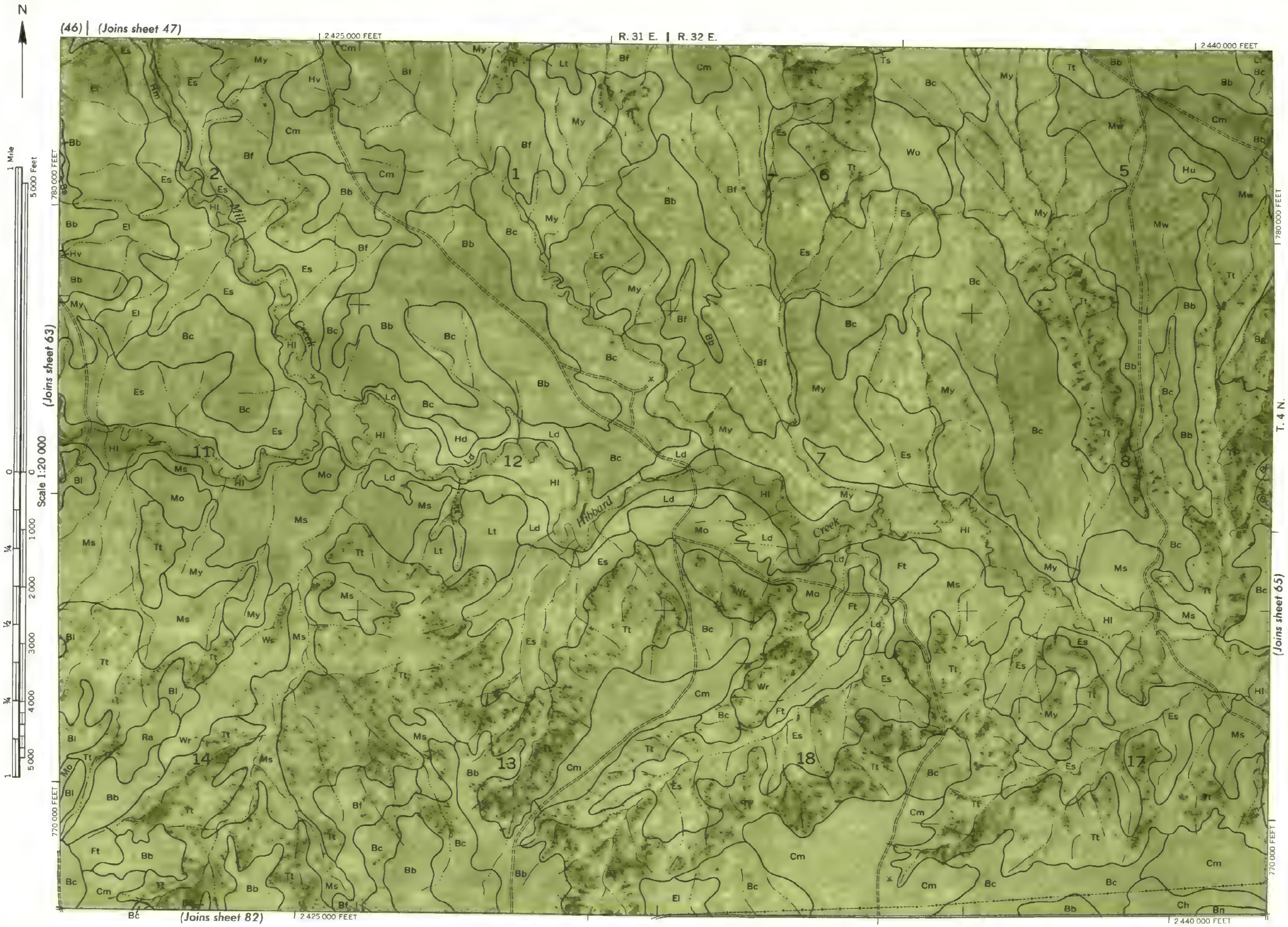


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 64



YELLOWSTONE COUNTY, MONTANA NO. 64

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

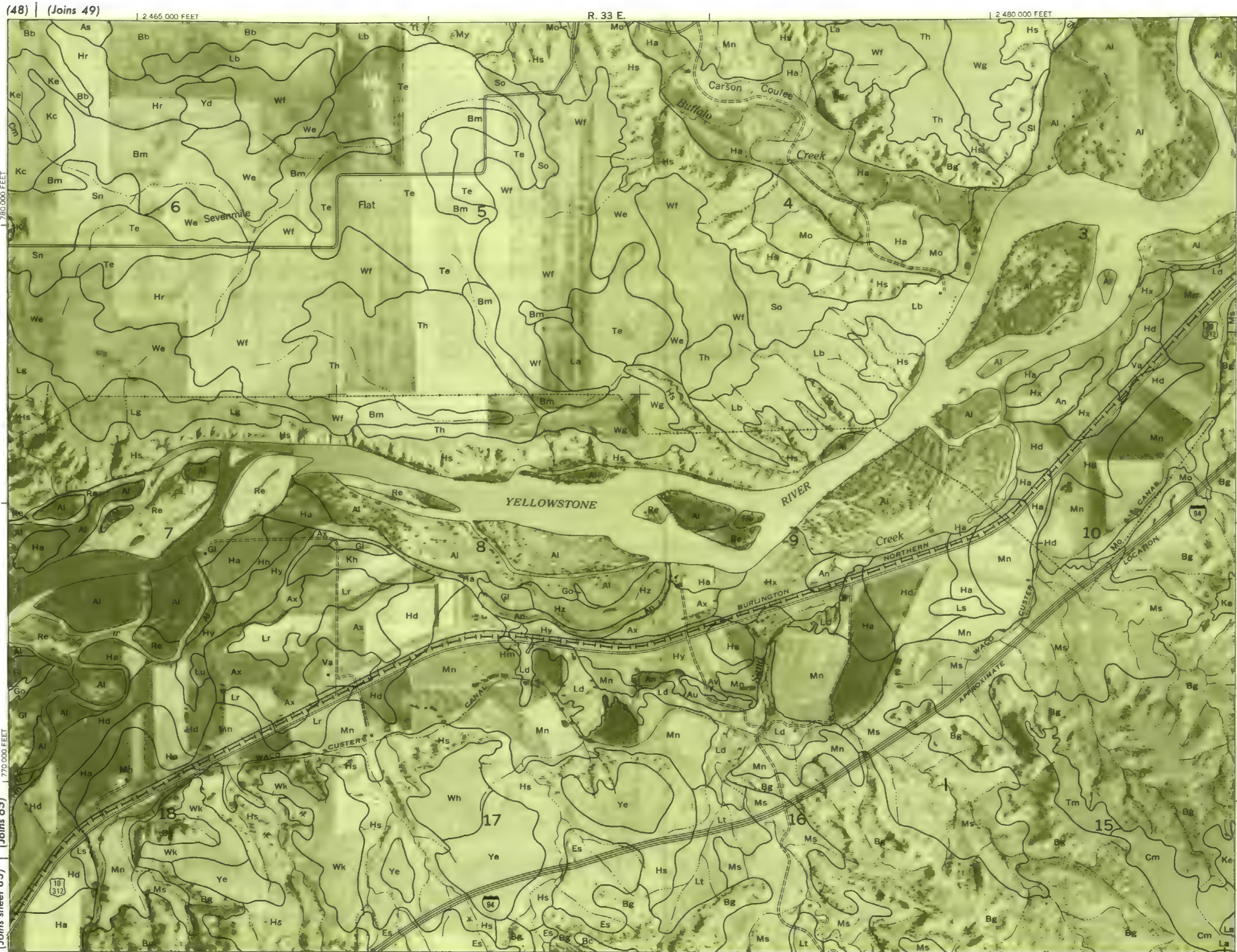
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

(66)

(48) | (Joins 49)

R. 33 E.



N

1 Mile

5 000 Feet

Scale 1:20 000

T. 4 N.

(Joins sheet 67)

(Joins sheet 84)

(Joins sheet 83) | (Joins 65)

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 66

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 66

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

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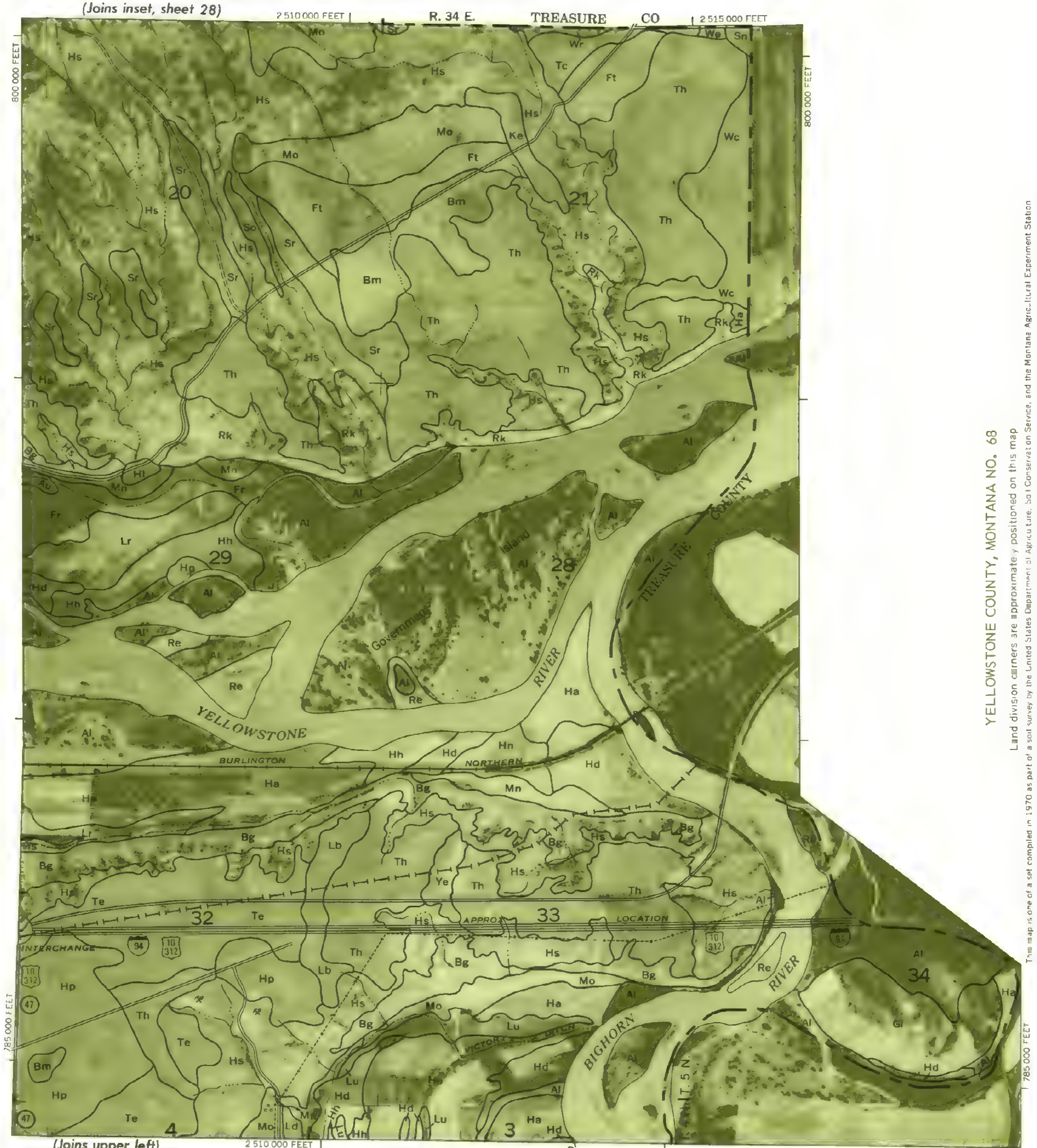
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 67

Photobase from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 67

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 68



YELLOWSTONE COUNTY, MONTANA NO. 68

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

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Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 69

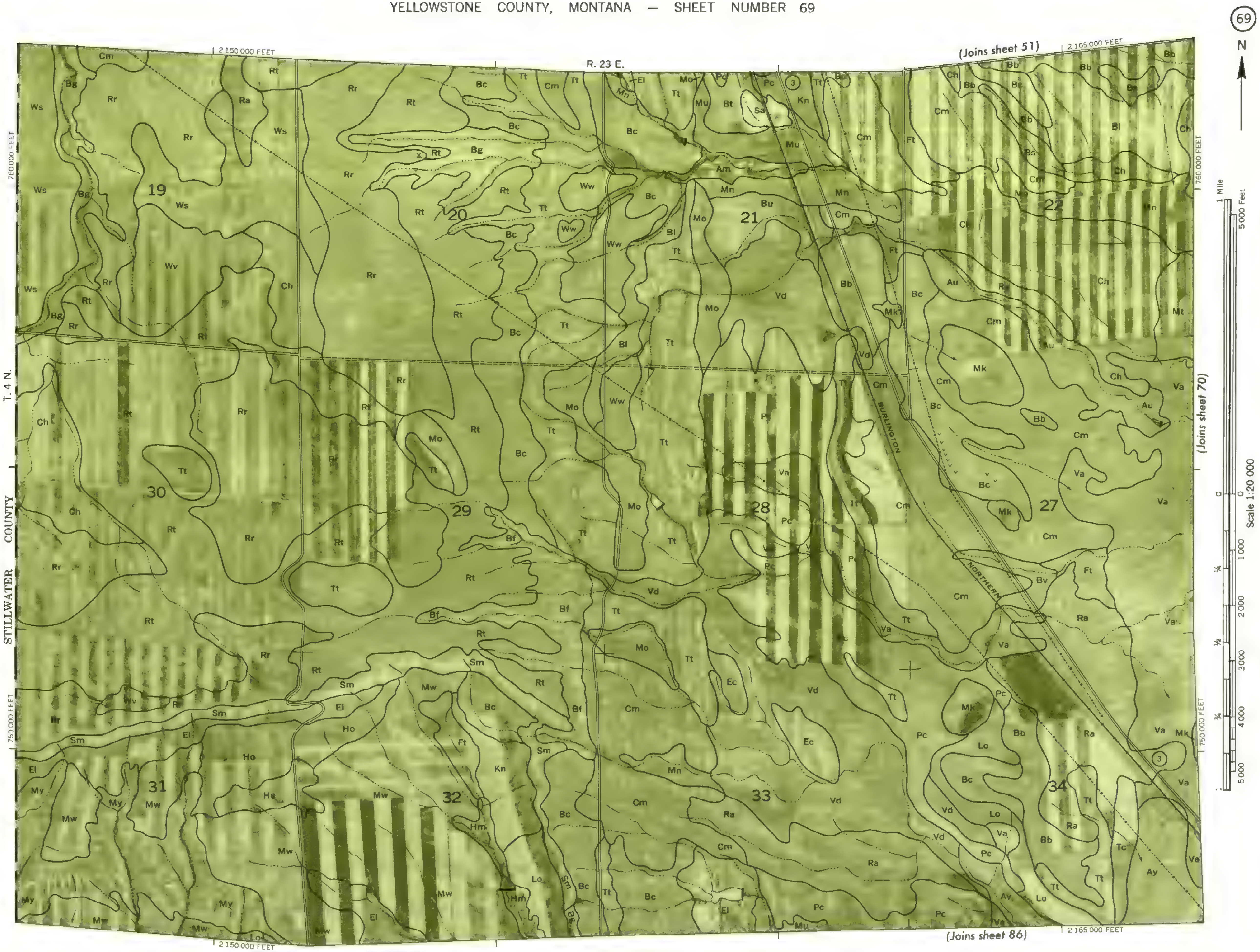
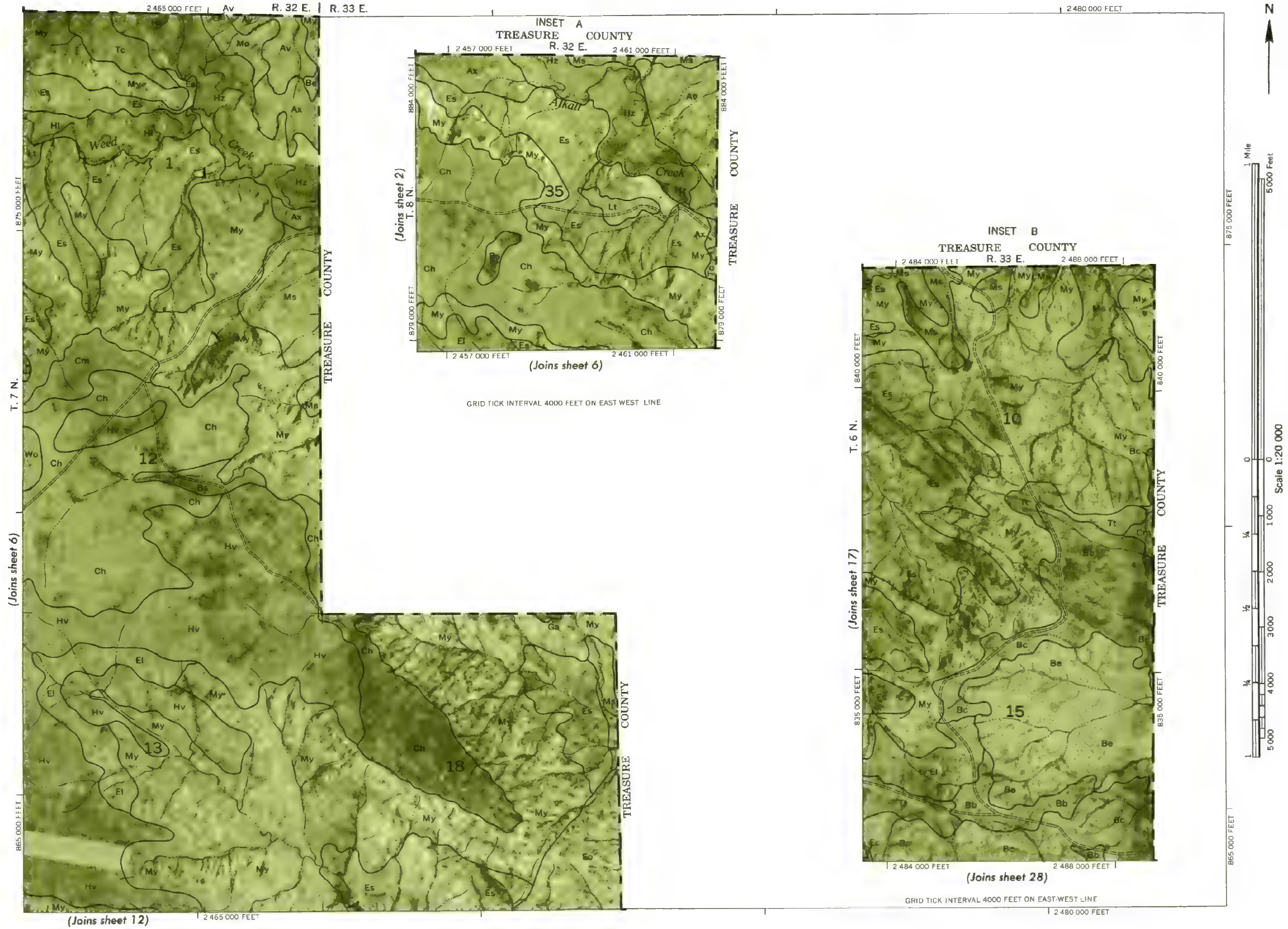


Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 7

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 70

YELLOWSTONE COUNTY, MONTANA NO. 70

Land division corners are approximately positioned on this map.

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Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

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Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 71

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

72

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 72

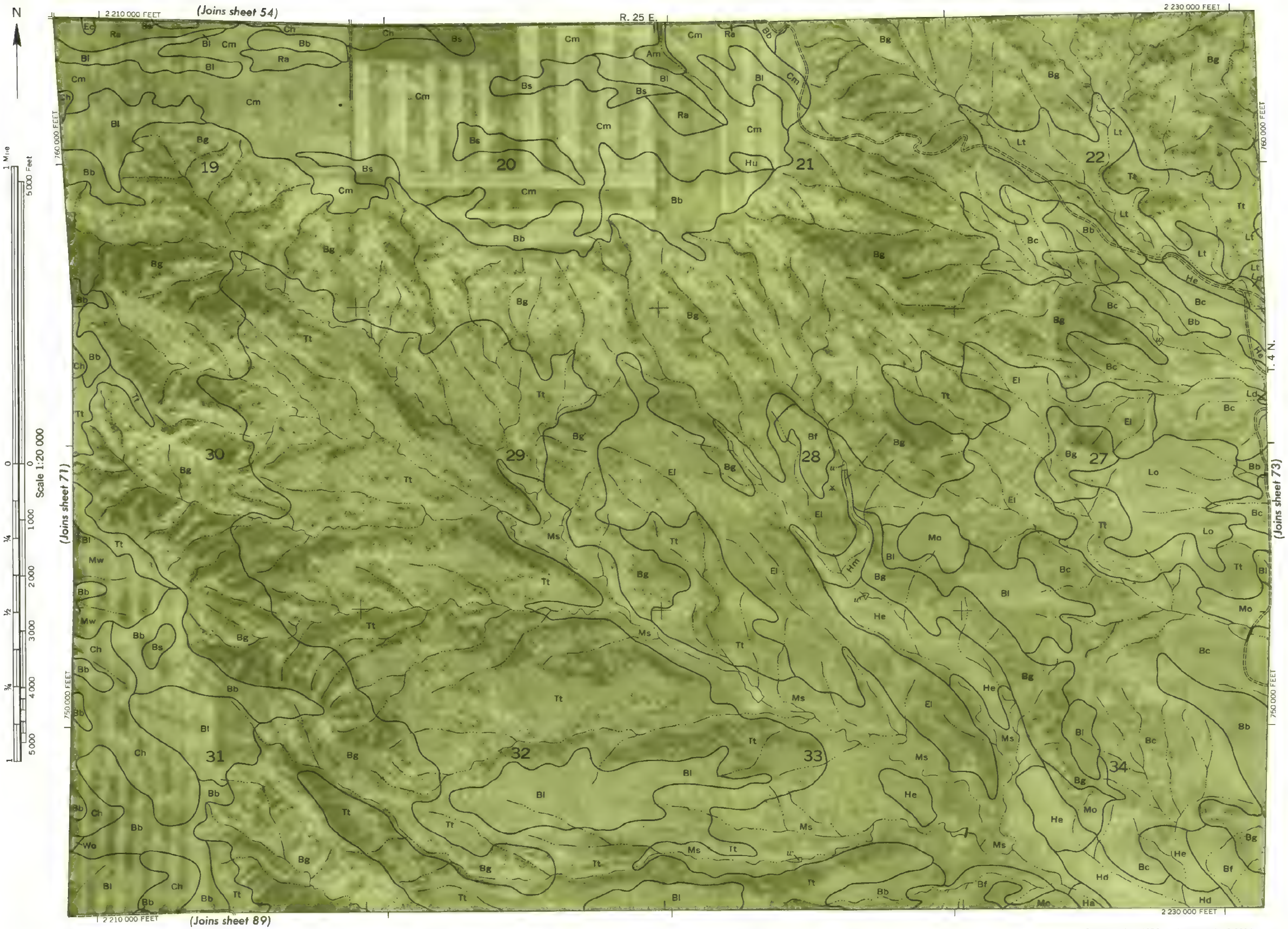
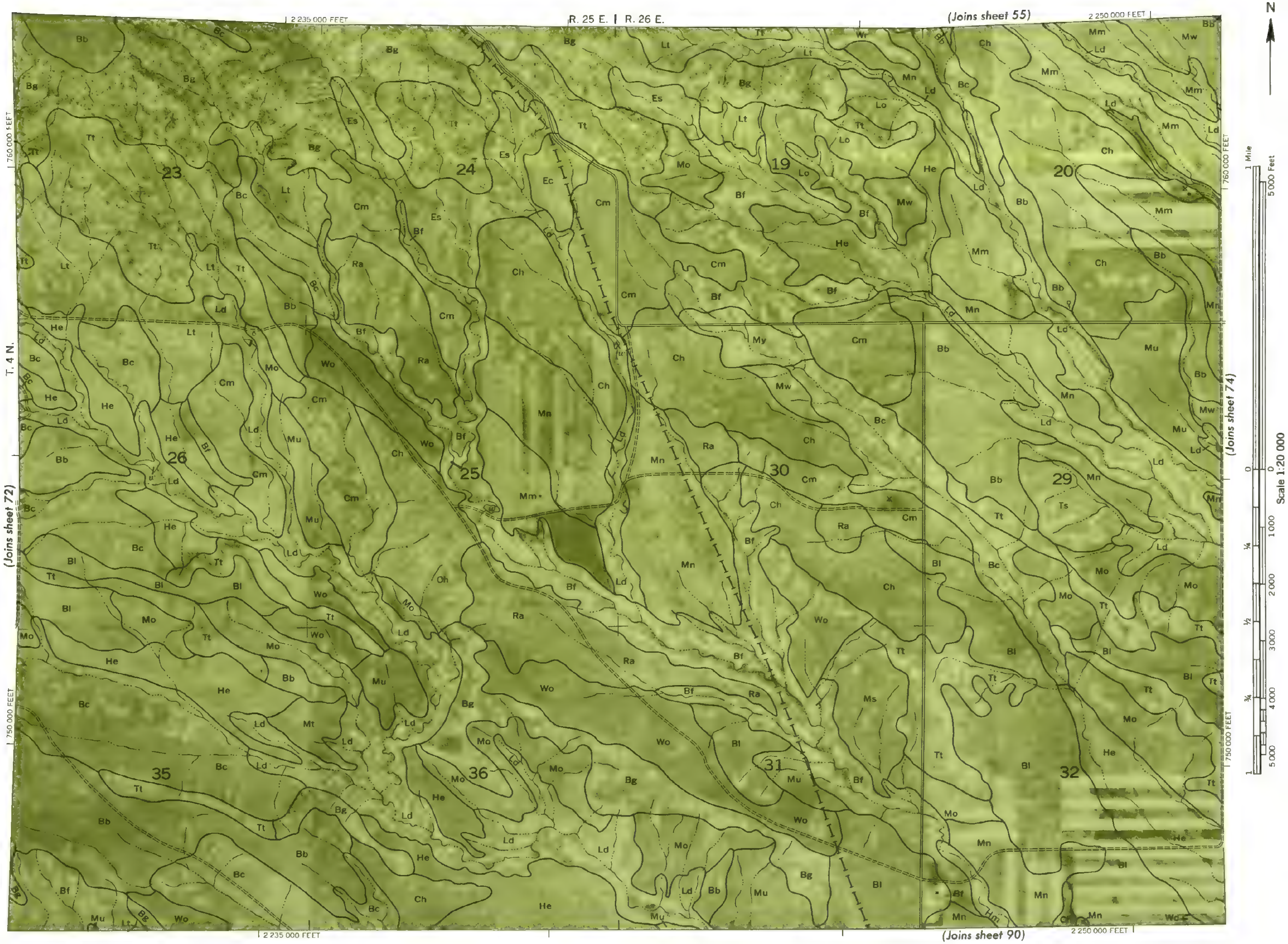


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 72

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.



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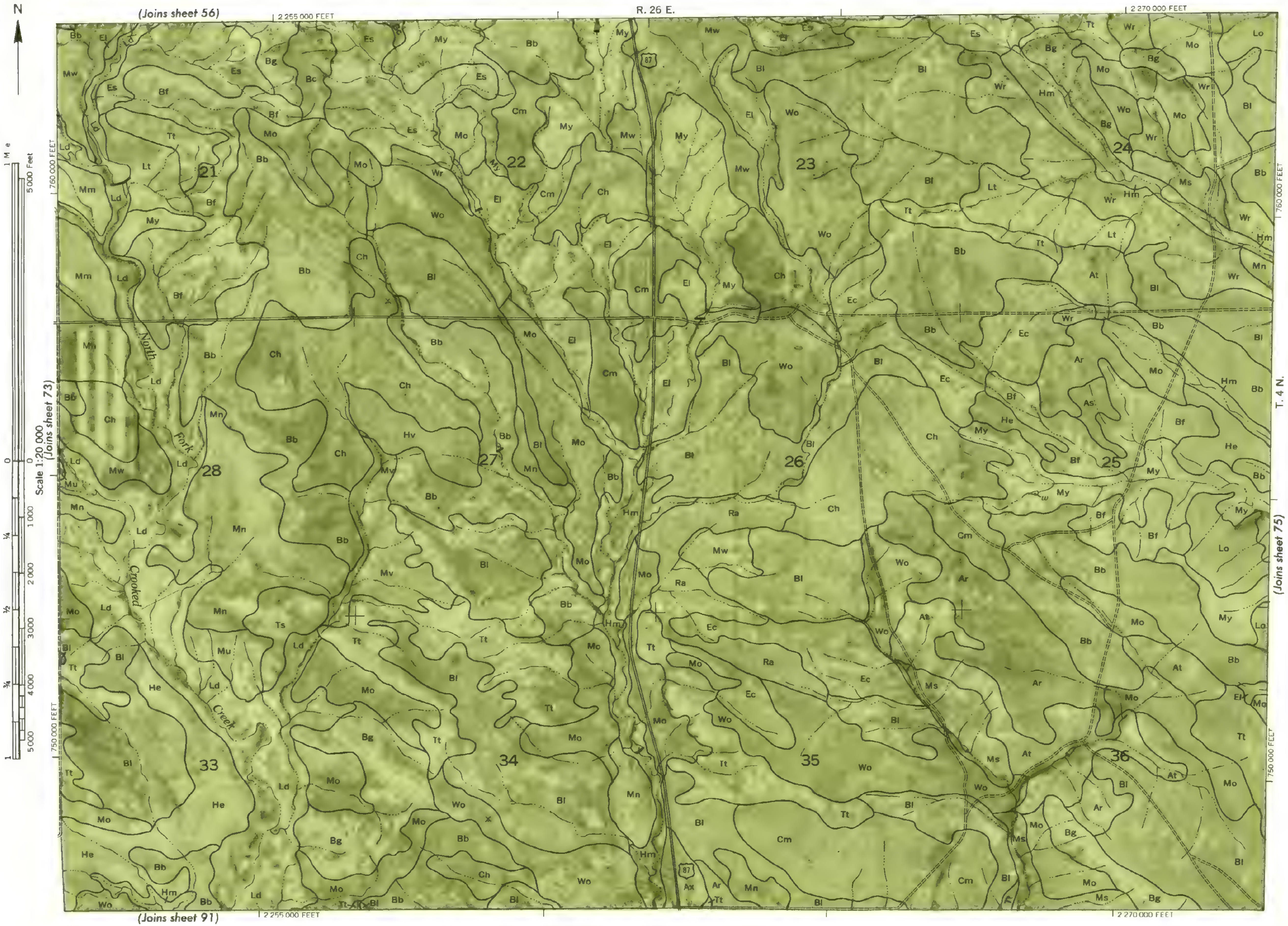
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 73

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 74



YELLOWSTONE COUNTY, MONTANA NO. 74

Land division corners are approximately positioned on this map.

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Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

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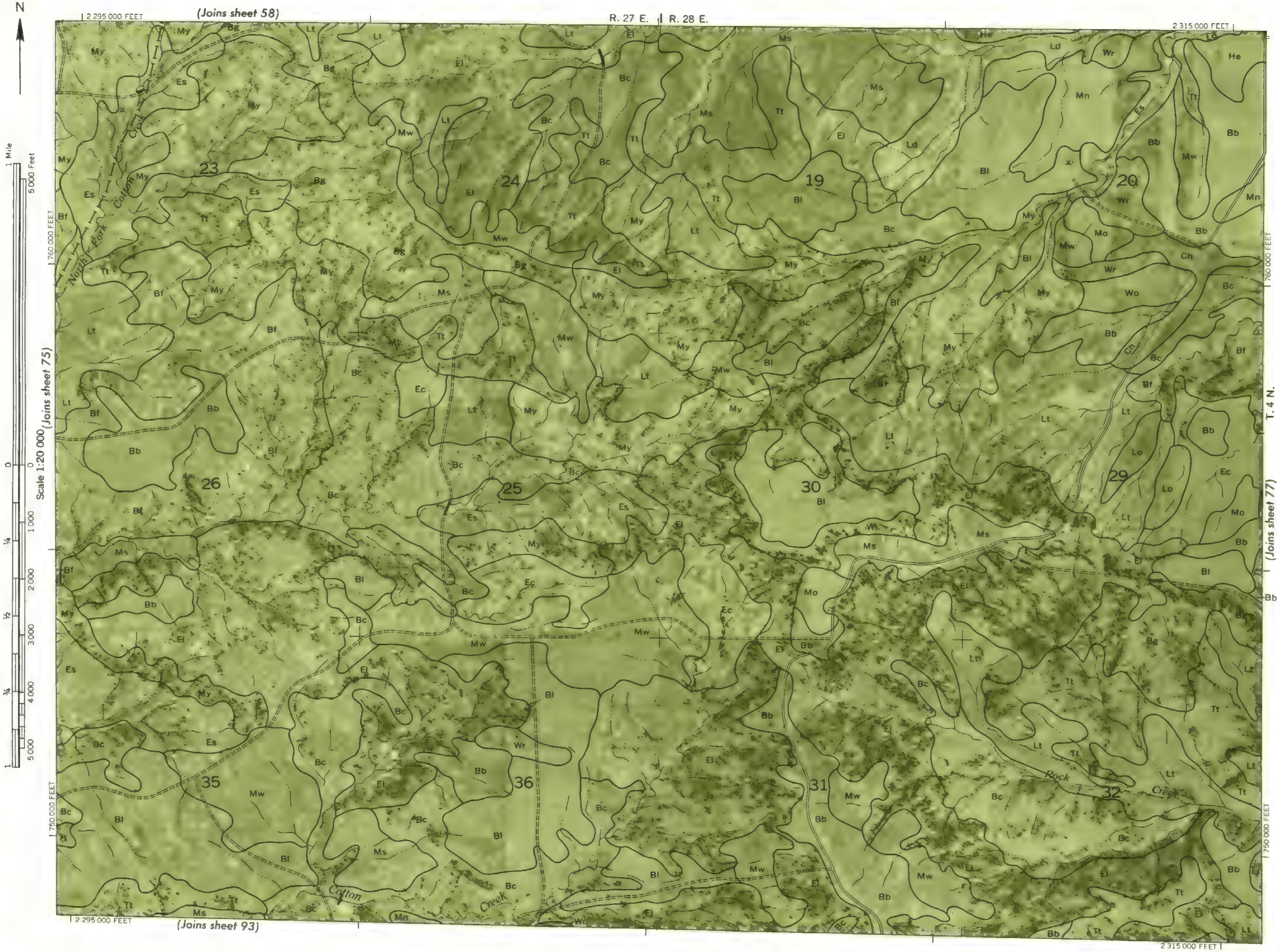
YELLOWSTONE COUNTY, MONTANA NO. 75

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 76



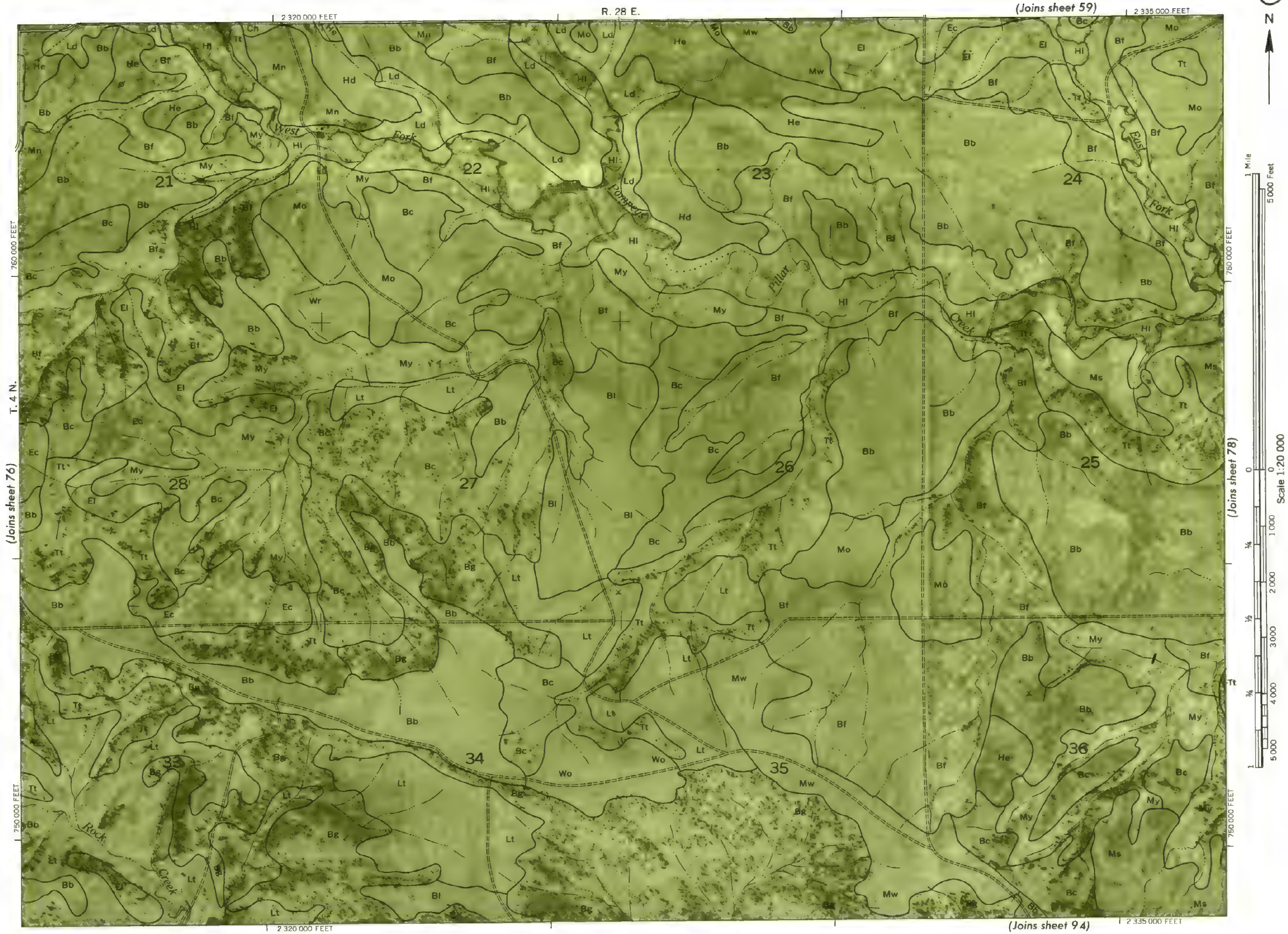
YELLOWSTONE COUNTY, MONTANA NO. 76

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 77

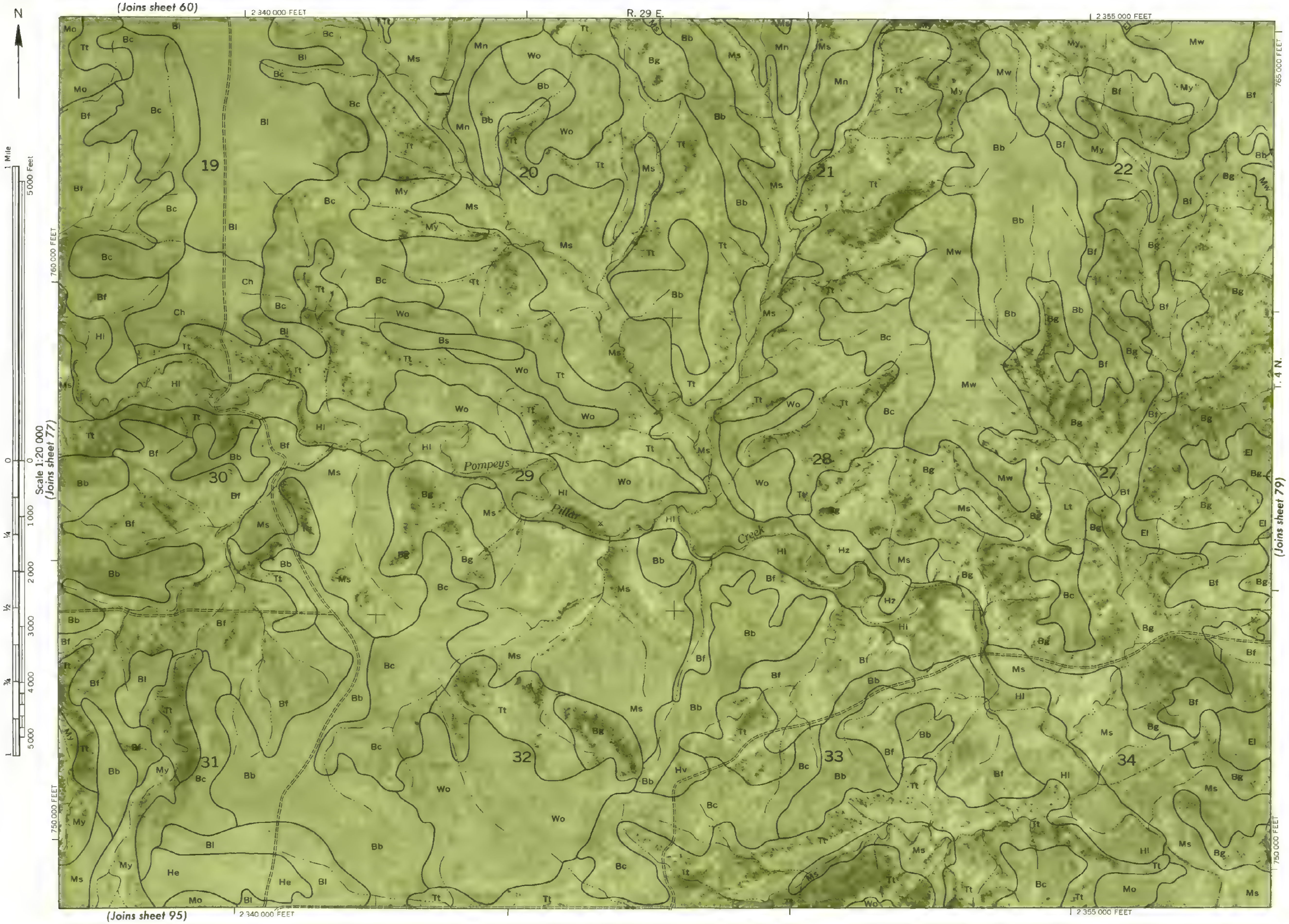


This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 77

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 78



YELLOWSTONE COUNTY, MONTANA NO. 78

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000 foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

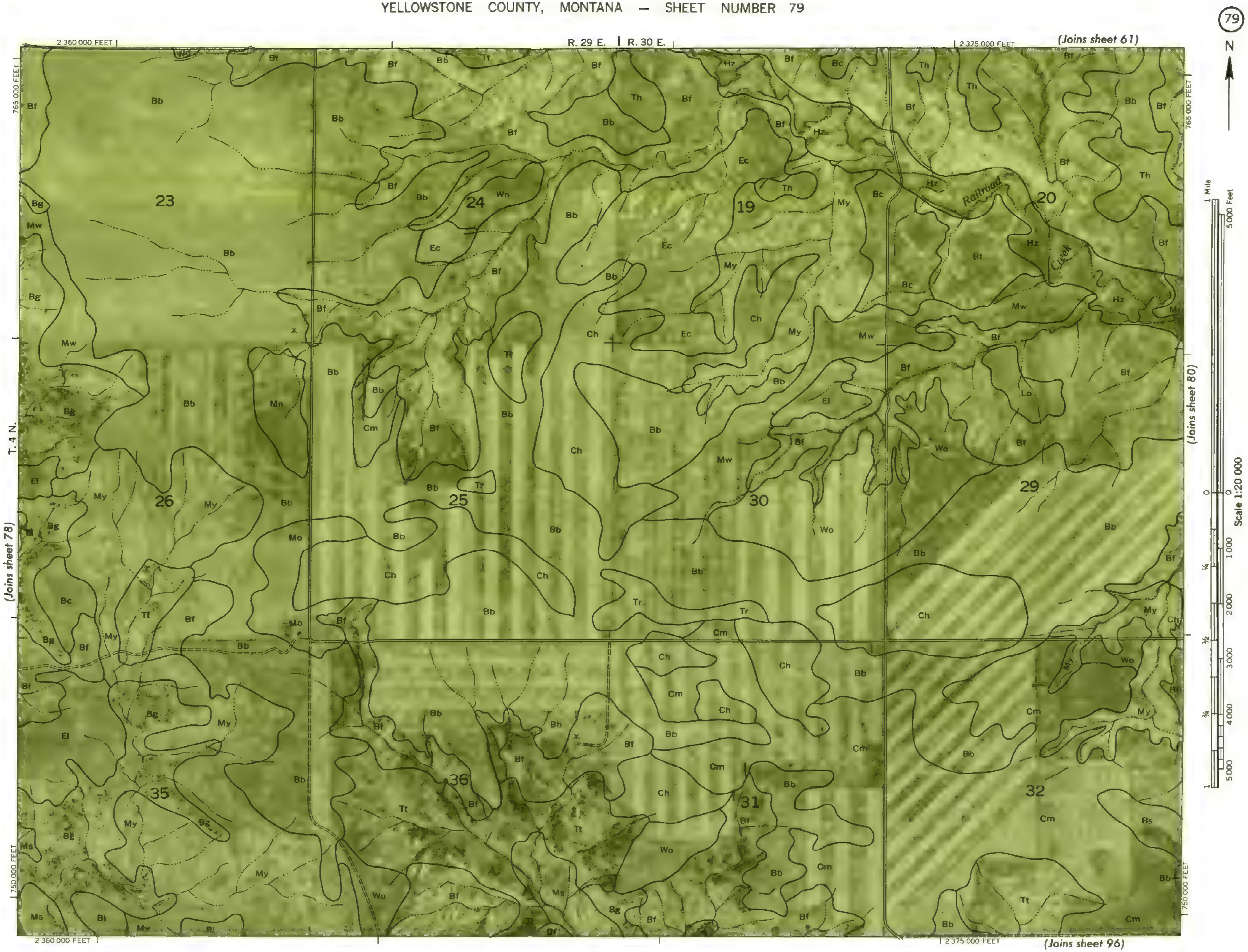


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 79

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 8

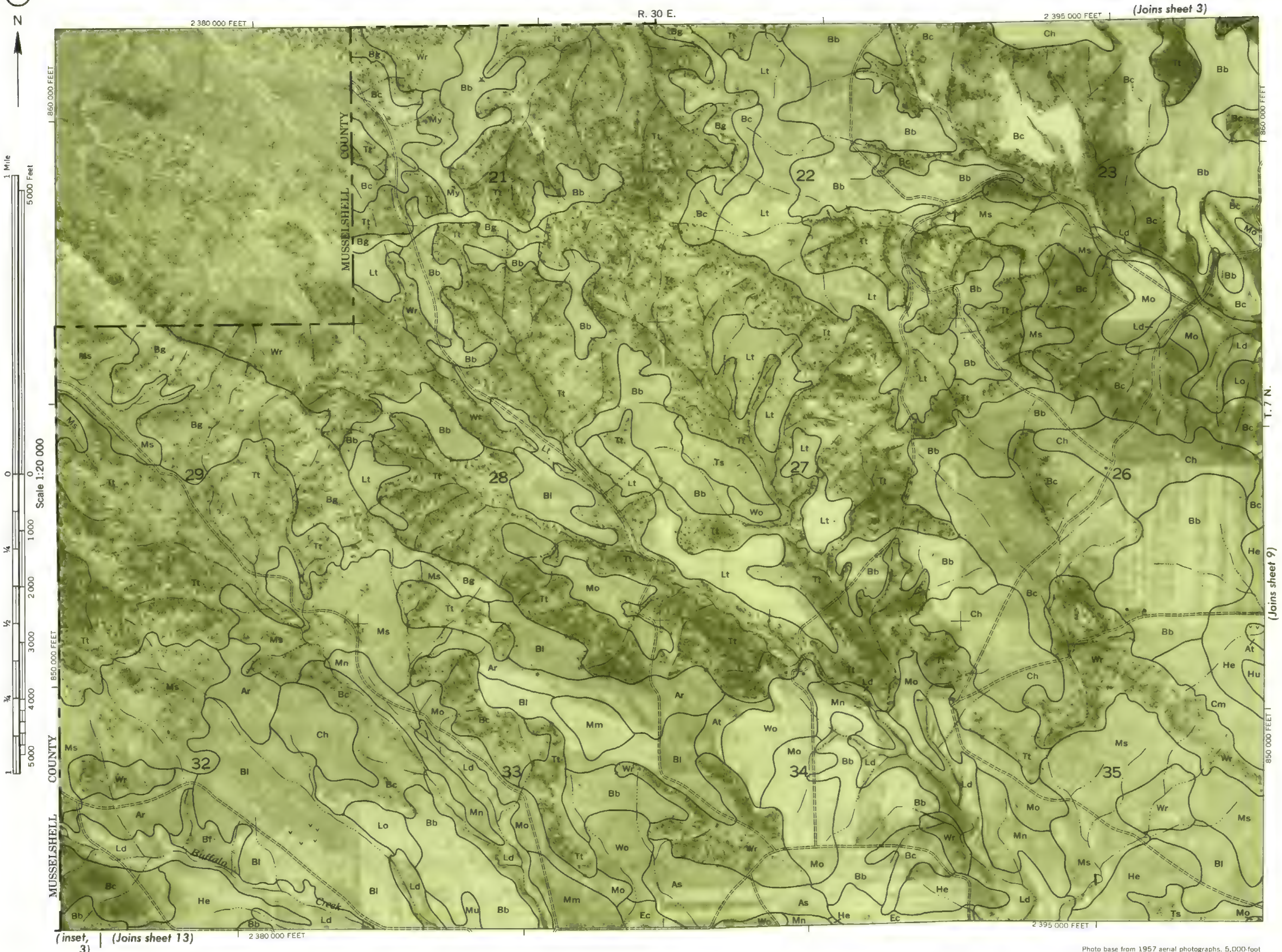


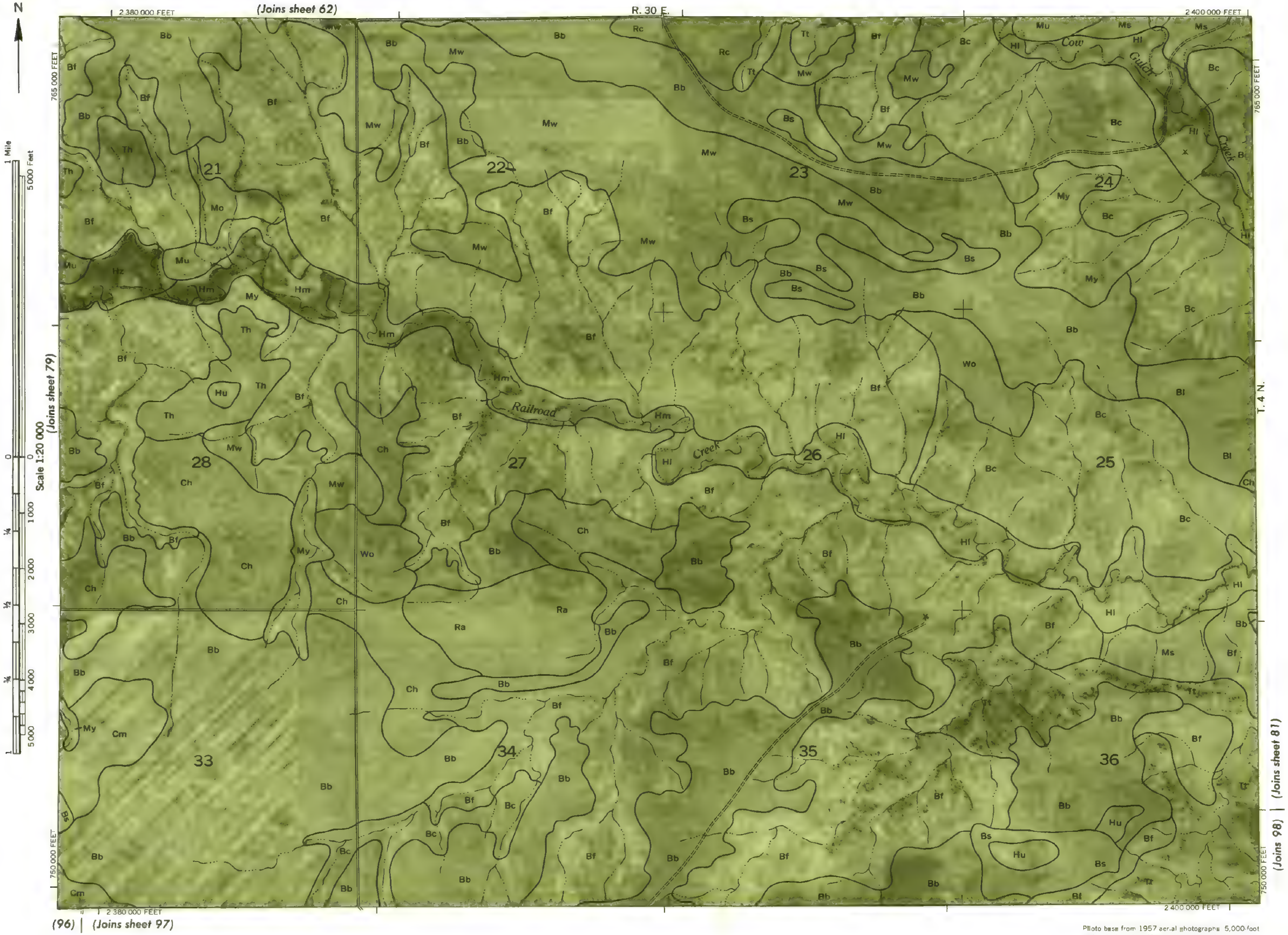
Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 8

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 80



YELLOWSTONE COUNTY, MONTANA NO. 80

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

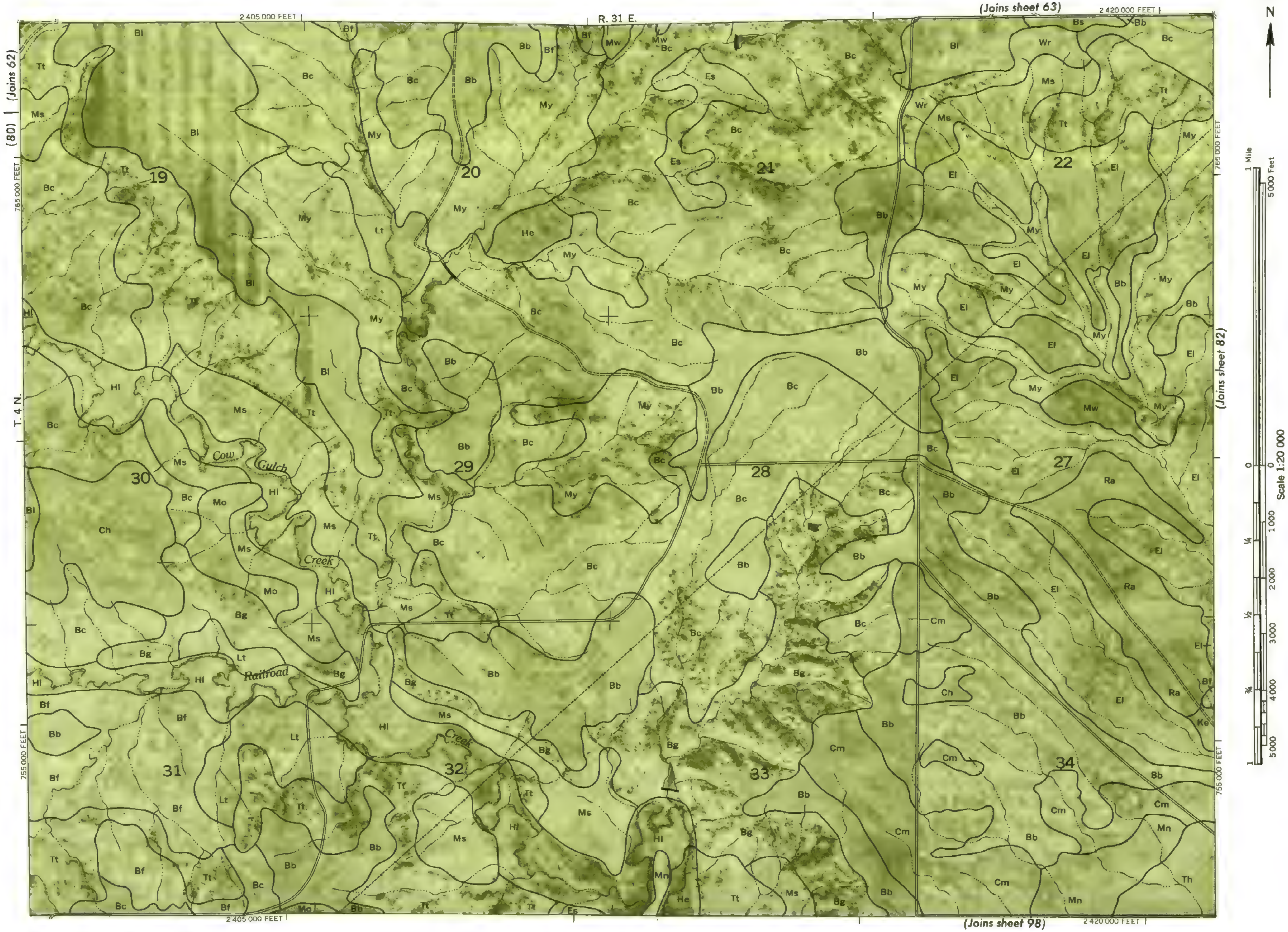


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 81

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 82

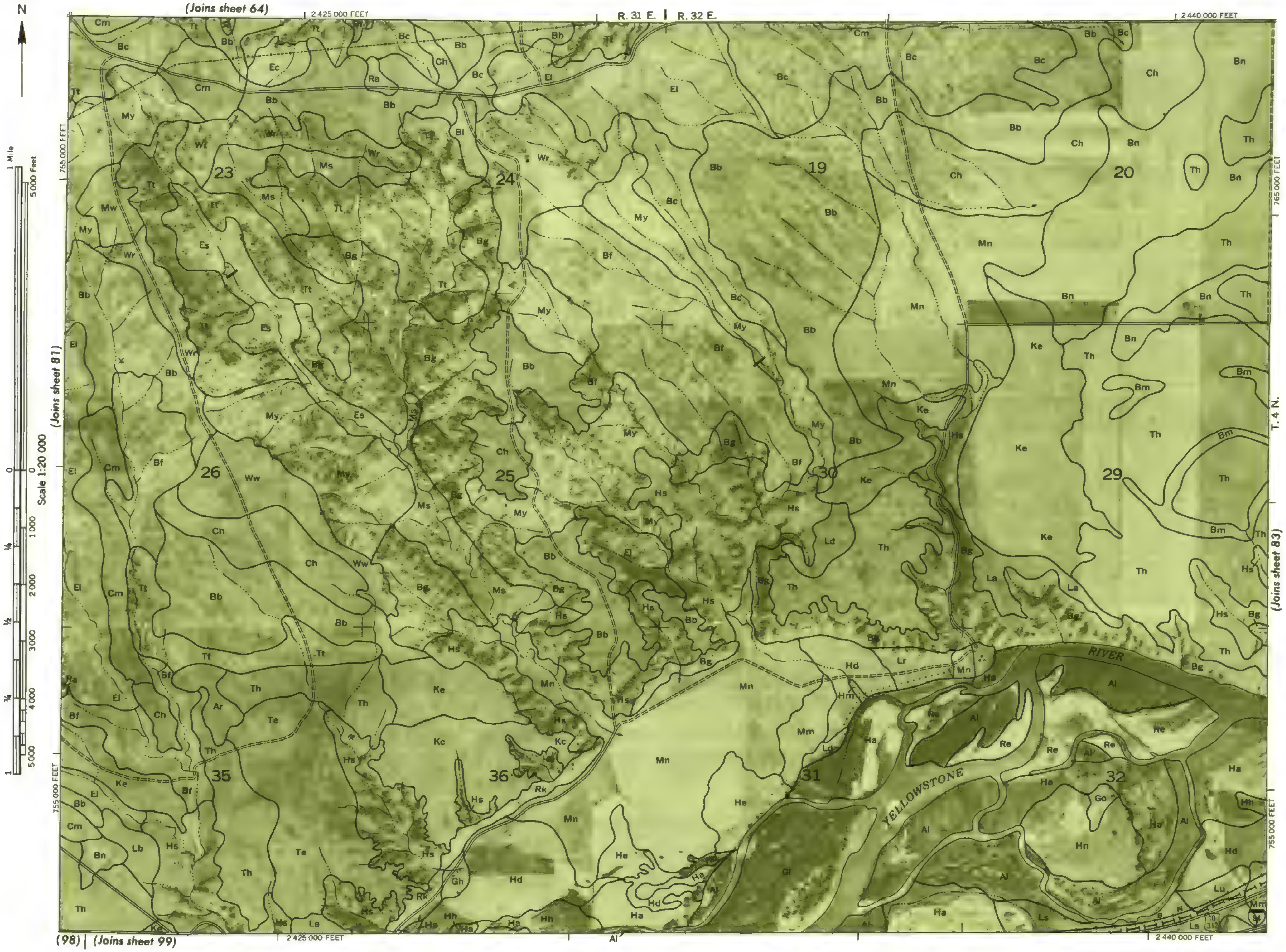


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA NO. 82

Land division corners are approximately positioned on this map.

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YELLOWSTONE COUNTY, MONTANA NO. 83

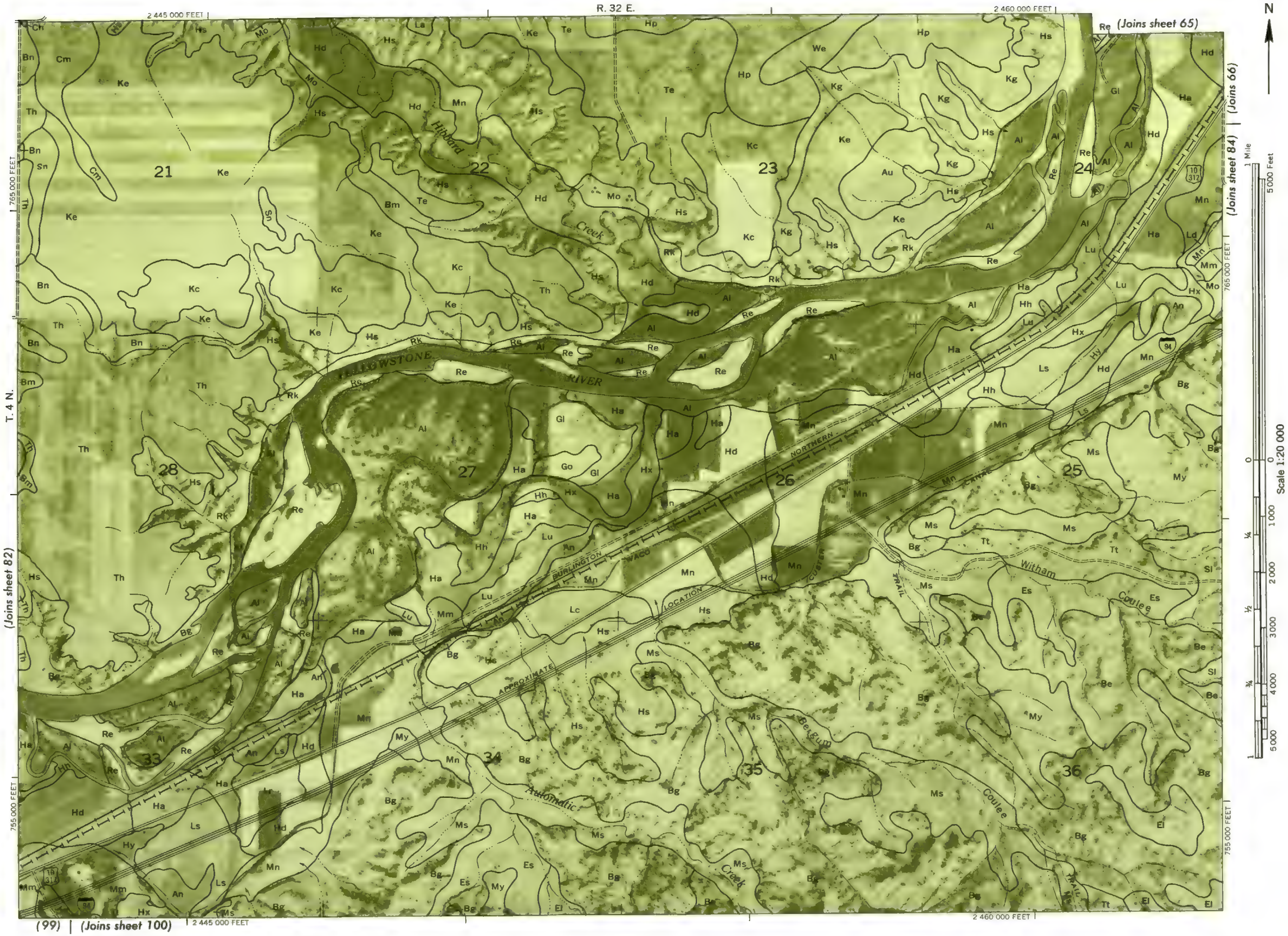


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum.

84

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 84

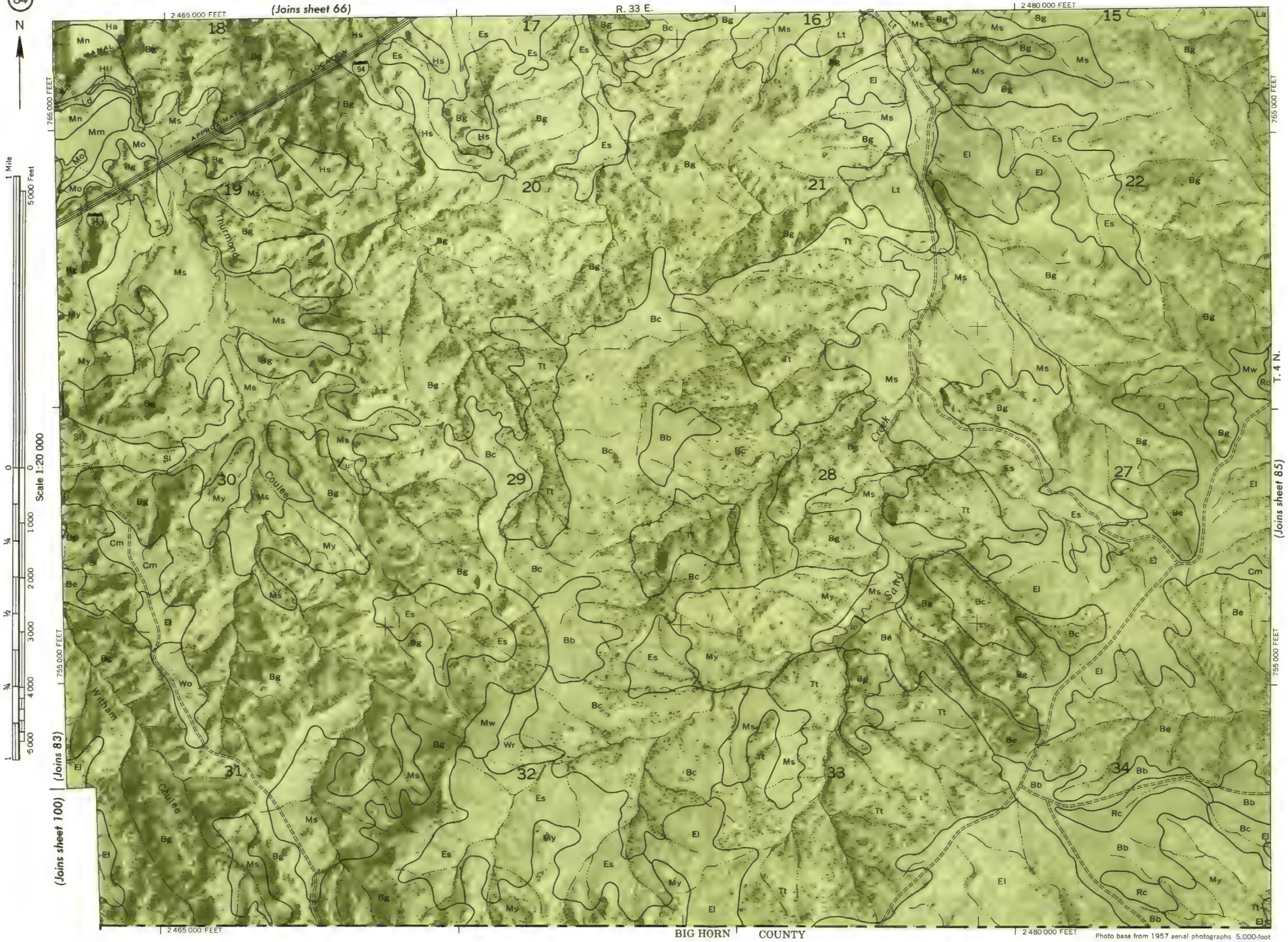


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 84

Land division corners are approximately positioned on this map

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 85

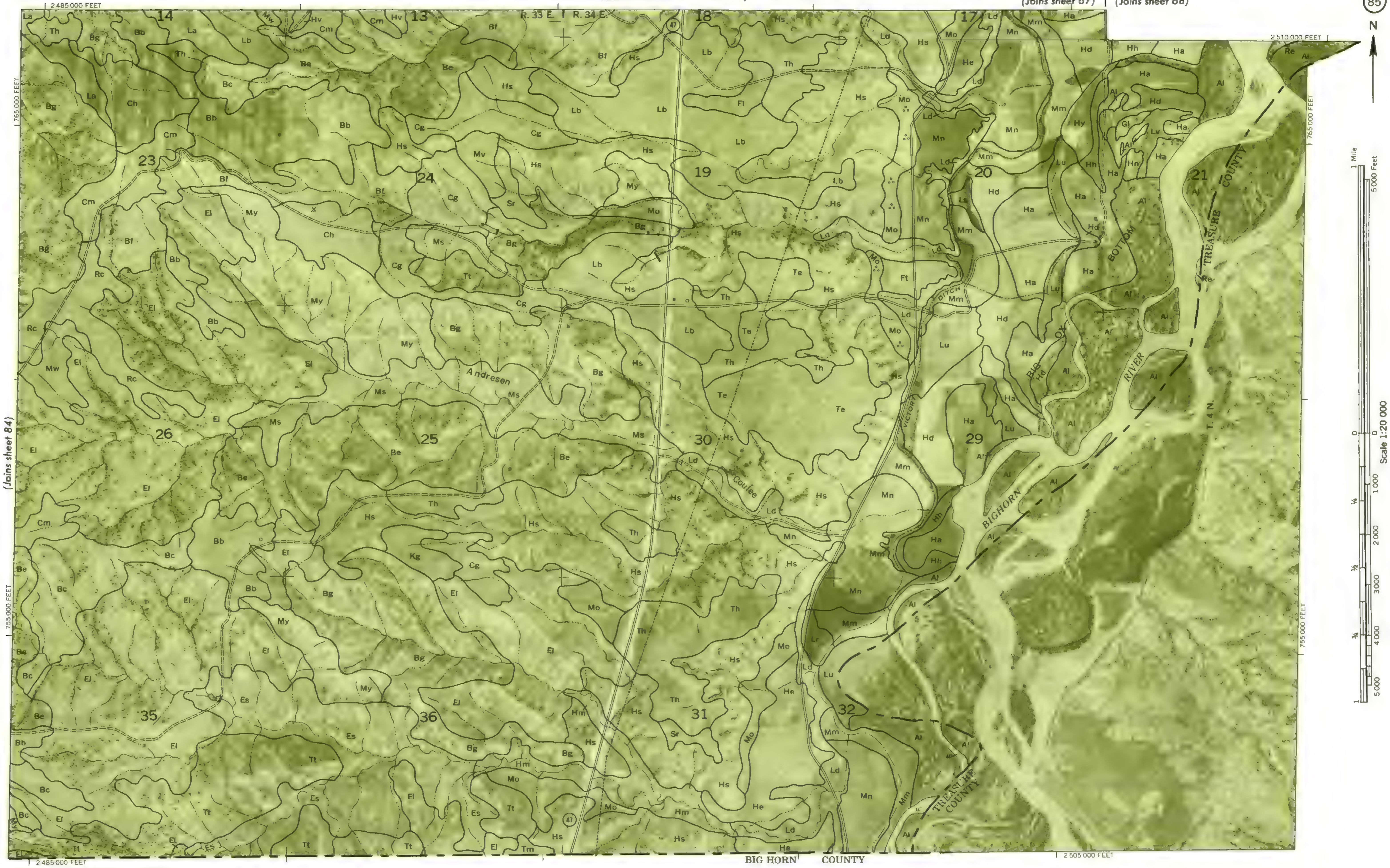
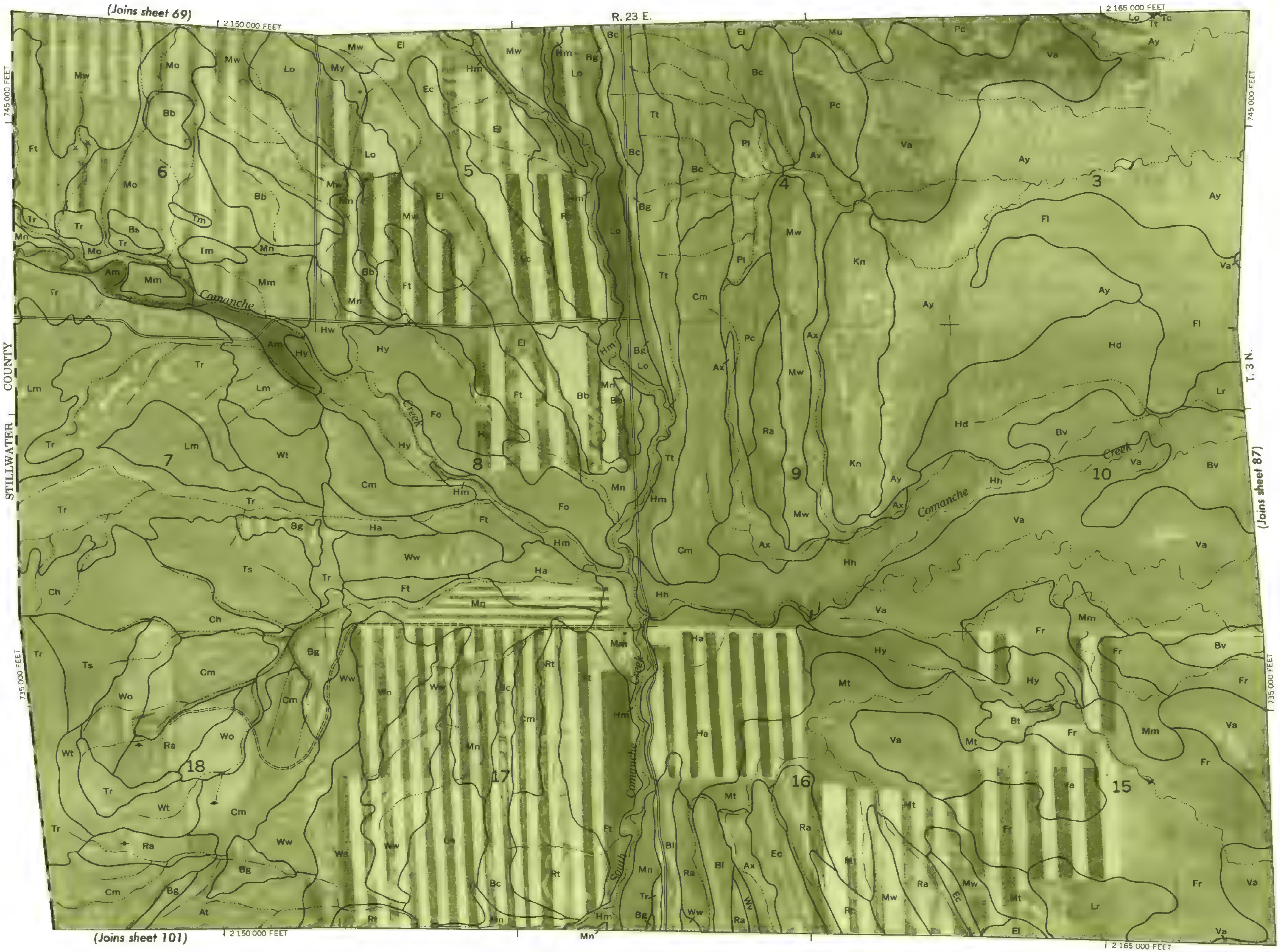


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 86

N



Scale 1:20 000

1 Mile ½ ¼ 0

5000 Feet 4000 3000 2000 1000 0

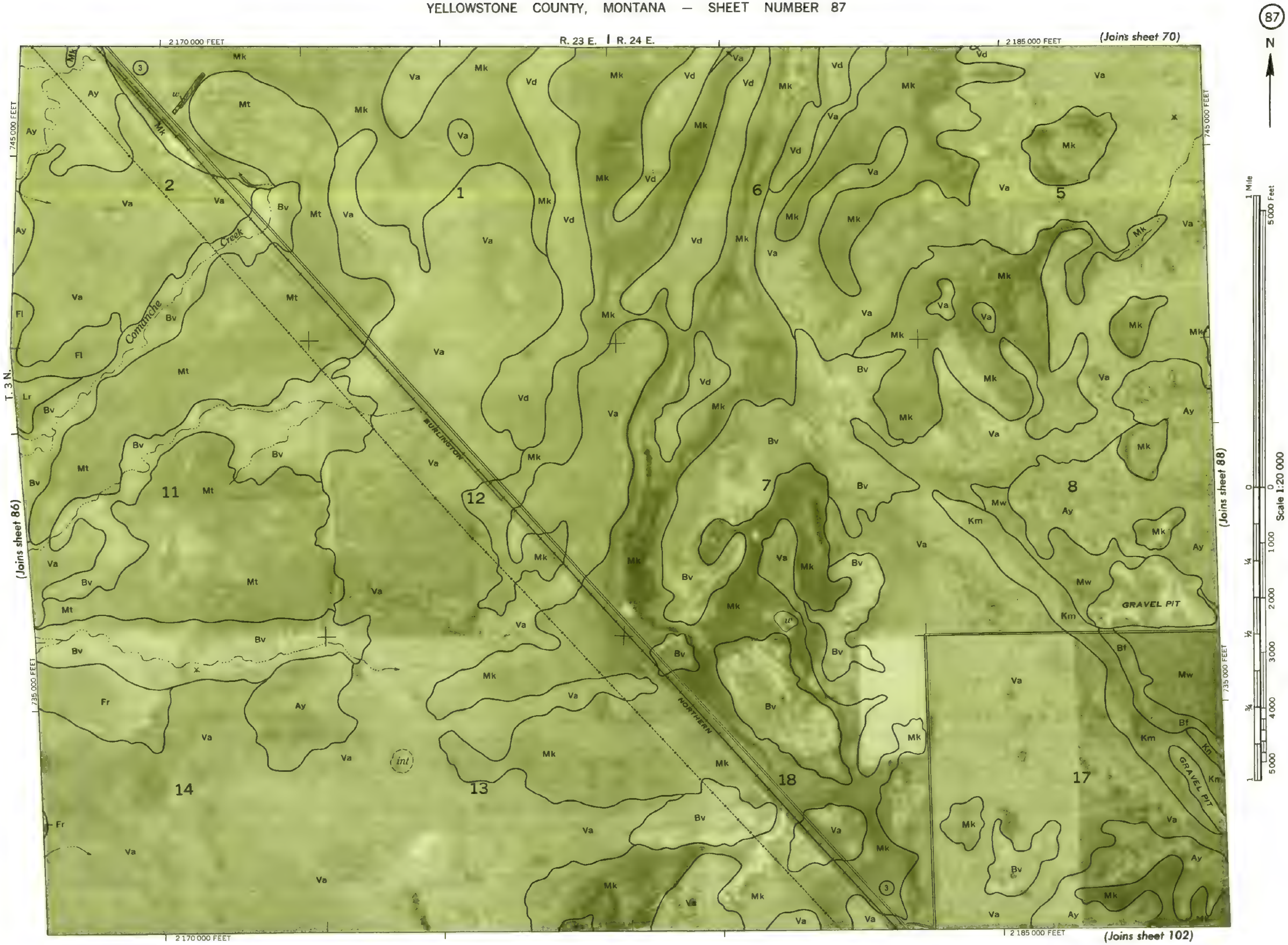
YELLOWSTONE COUNTY, MONTANA NO. 86

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 87



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 87

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum.

88

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 88

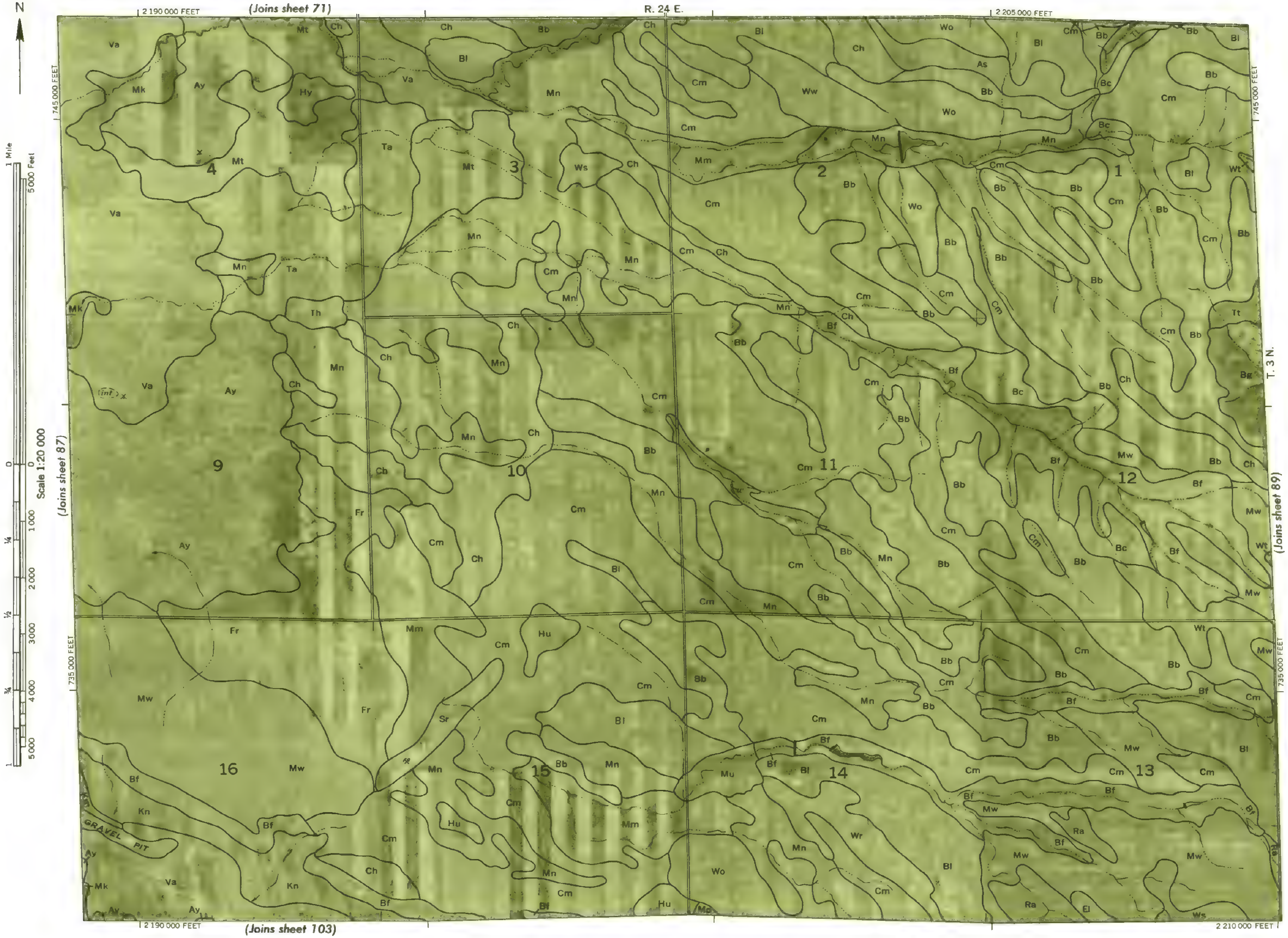


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 88

Land division corners are approximately positioned on this map.

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Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

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Land division corners are approximately positioned on this map

YELLOWSTONE COUNTY, MONTANA NO. 89

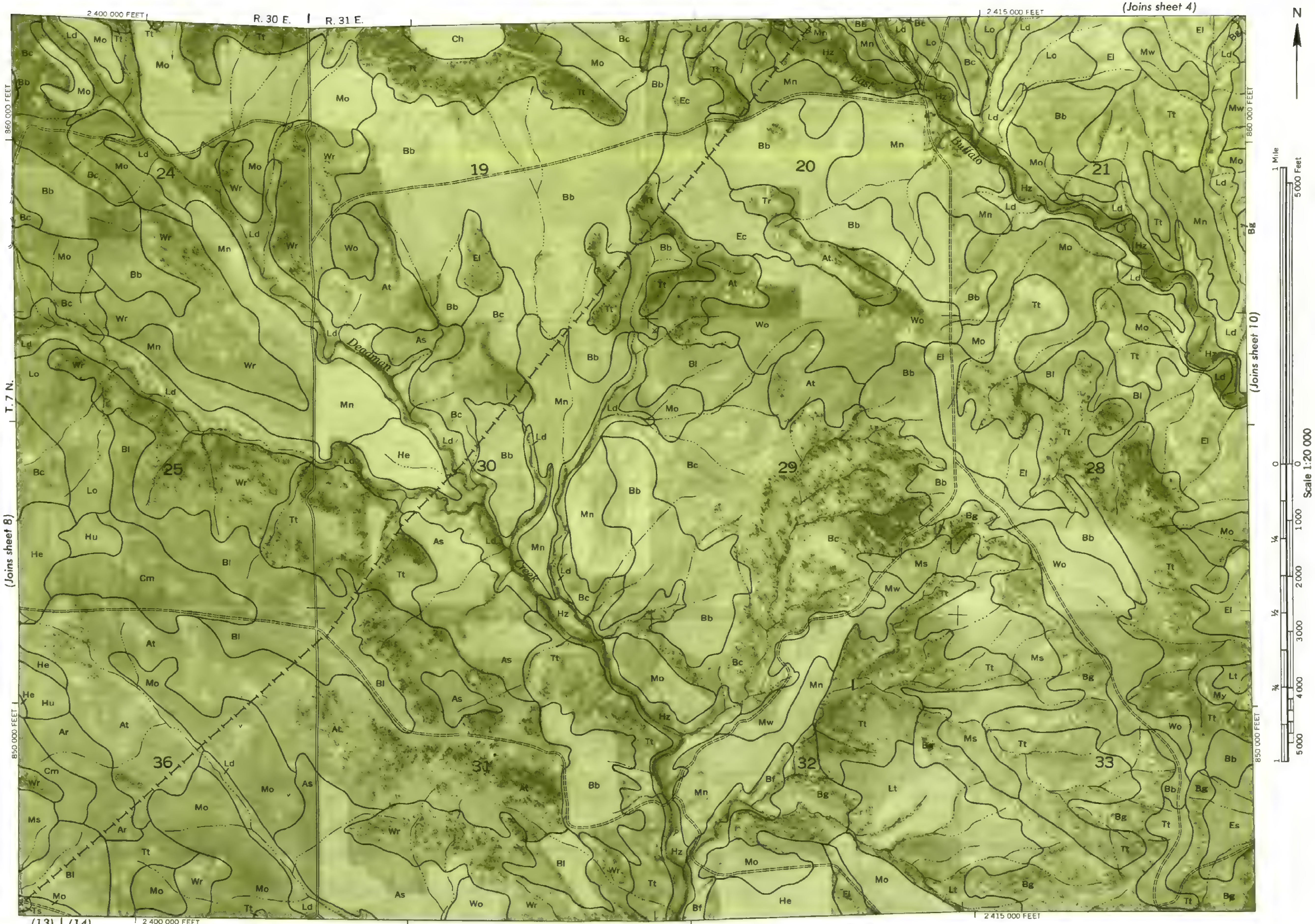

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

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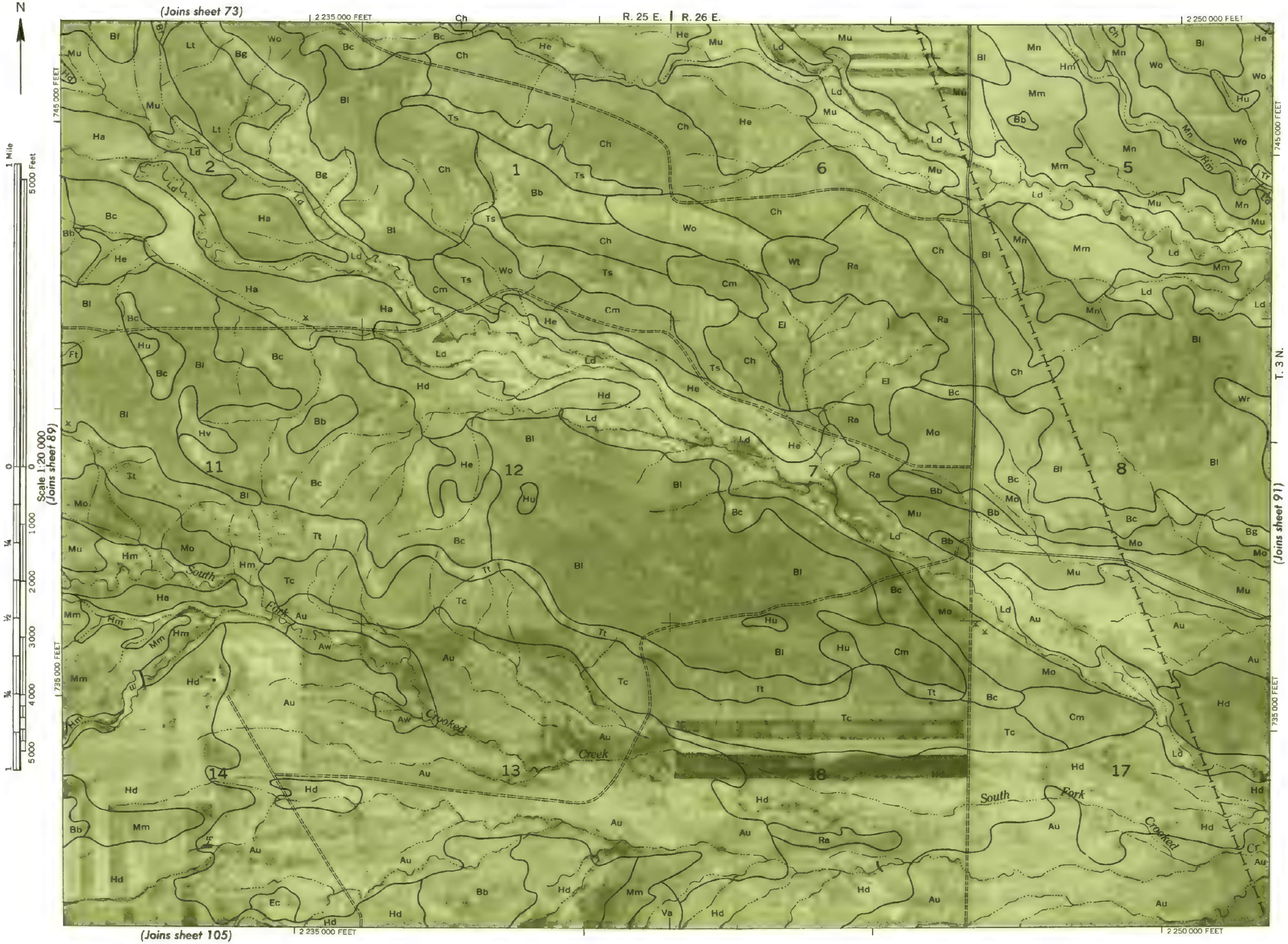
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 9

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 90



YELLOWSTONE COUNTY, MONTANA NO. 90

Land division corners are approximately positioned on this map.

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YELLOWSTONE COUNTY, MONTANA NO. 91

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 92

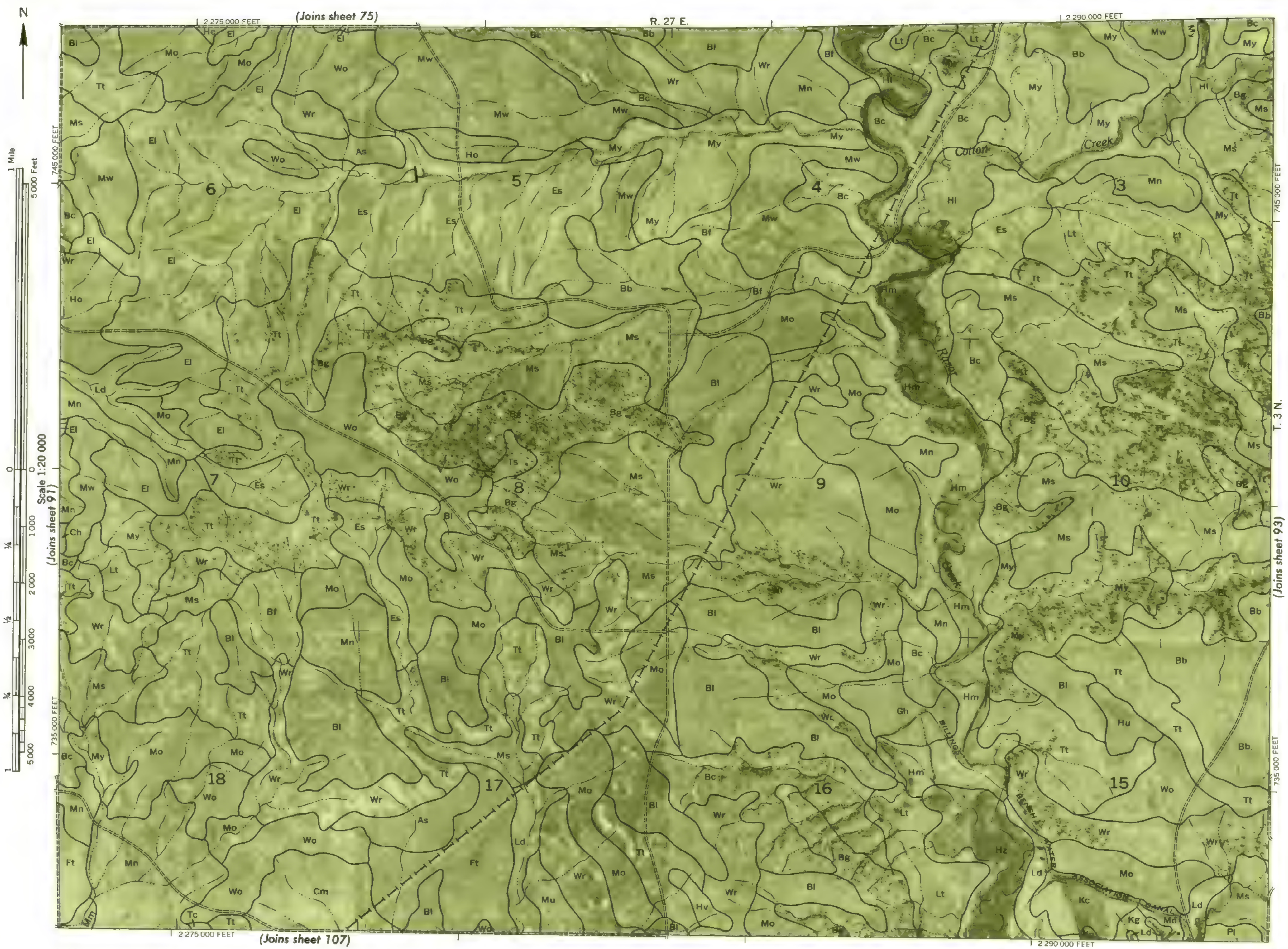


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone, 1927 North American datum

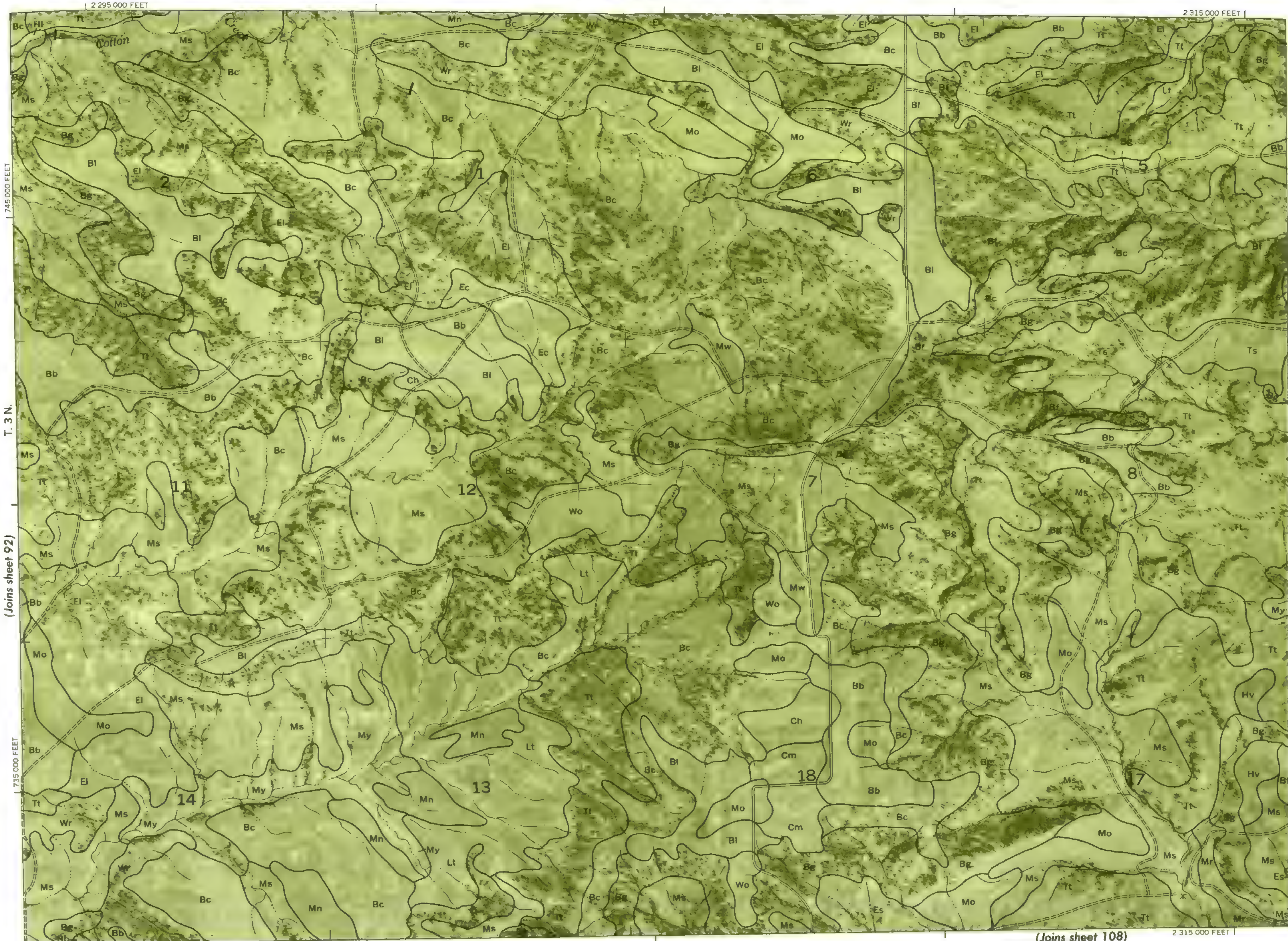
YELLOWSTONE COUNTY, MONTANA NO. 92

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

(75) | (Joins sheet 76)

R. 27 E. | R. 28 E.



N

Scale 1:20 000

1 Mile

0 ¼ ½ ¾

5000 Feet

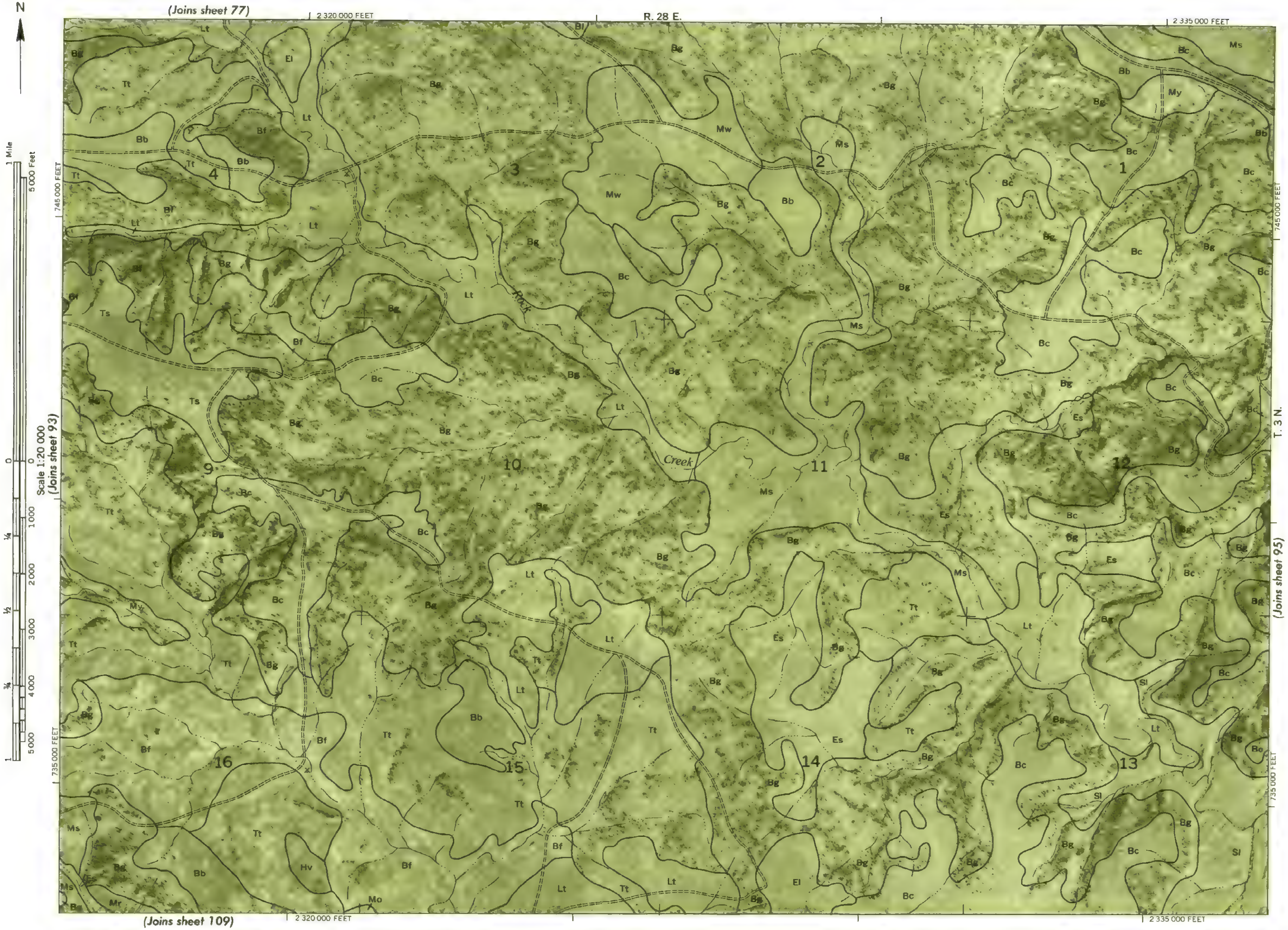
0 1000 2000 3000 4000 5000

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.

Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 94



YELLOWSTONE COUNTY, MONTANA NO. 94

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum

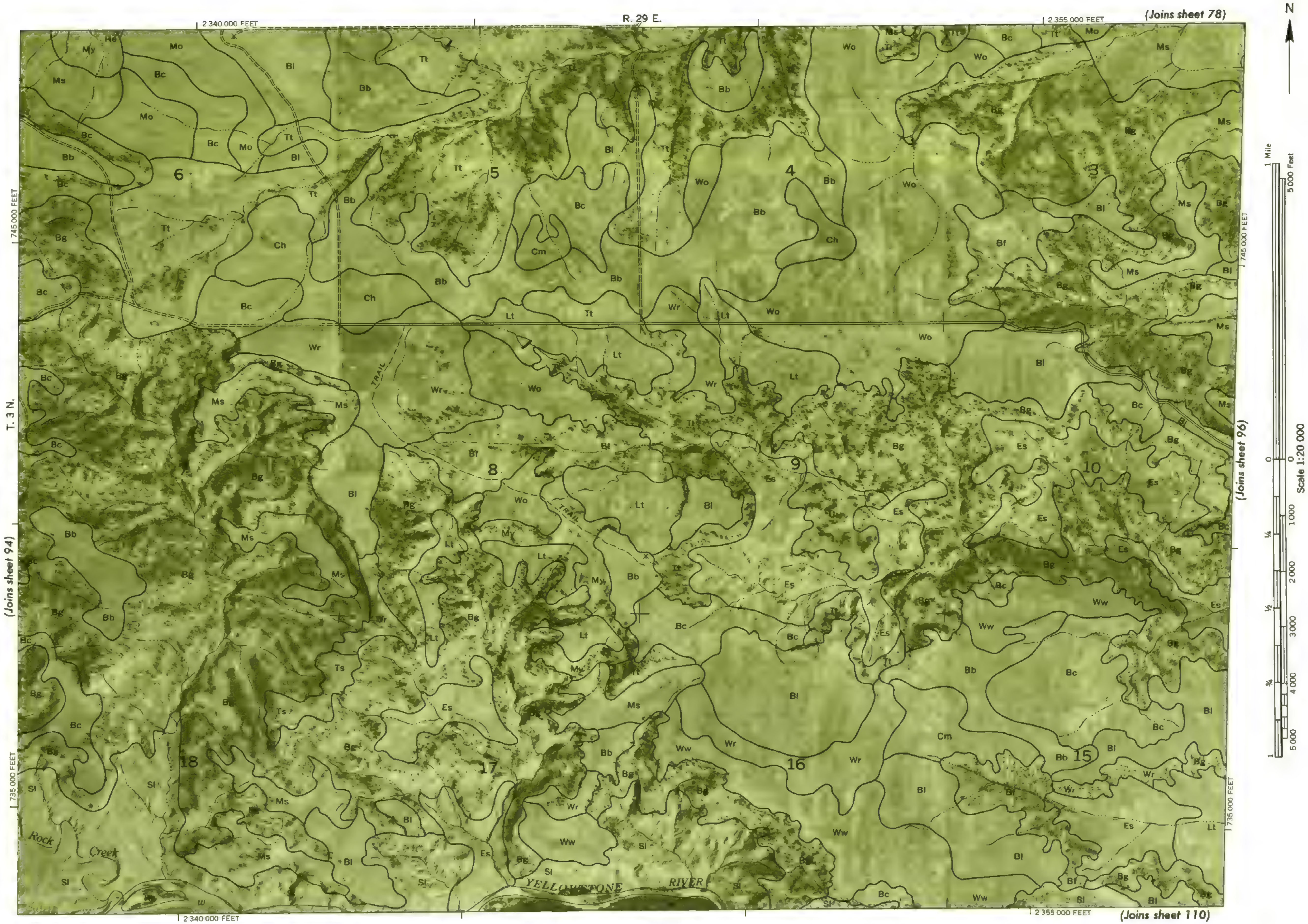


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

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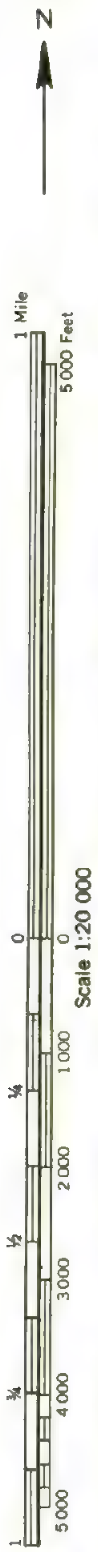
YELLOWSTONE COUNTY, MONTANA NO. 95

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 96



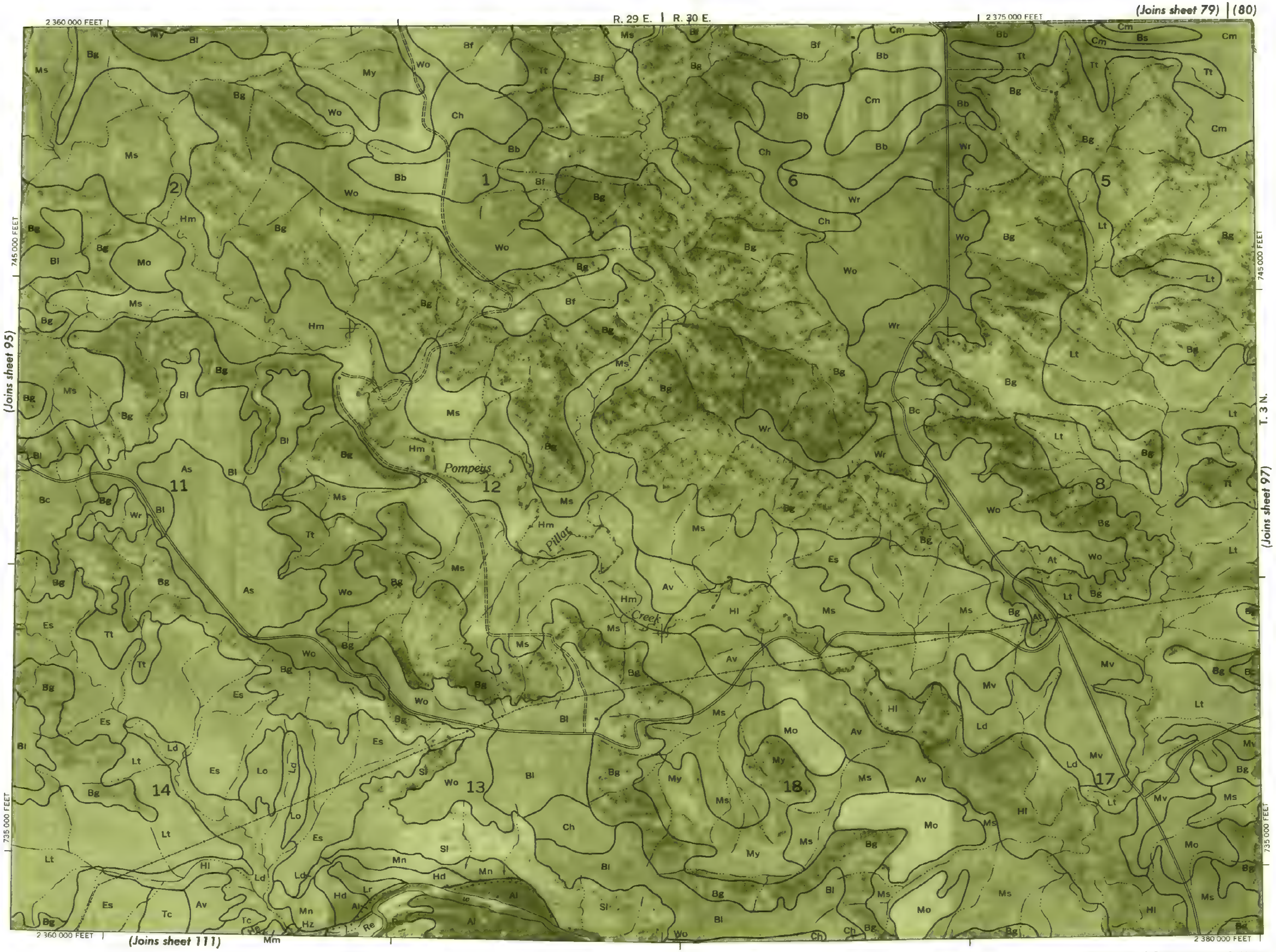


Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone 1927 North American datum

YELLOWSTONE COUNTY, MONTANA NO. 96

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 97

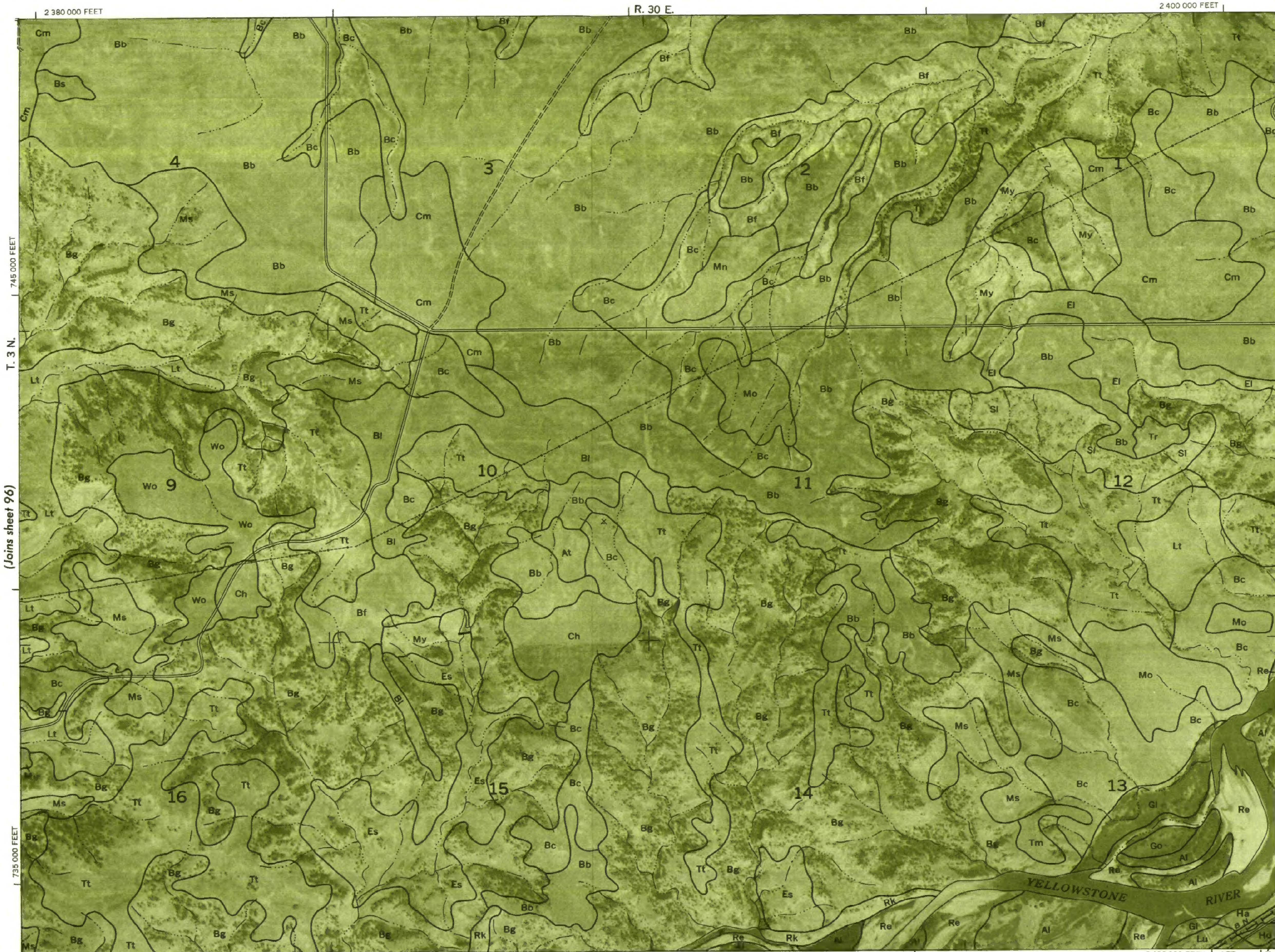
97

N

(Joins sheet 80)

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Montana Agricultural Experiment Station.
Land division corners are approximately positioned on this map.

YELLOWSTONE COUNTY, MONTANA NO. 97



Scale 1:20 000

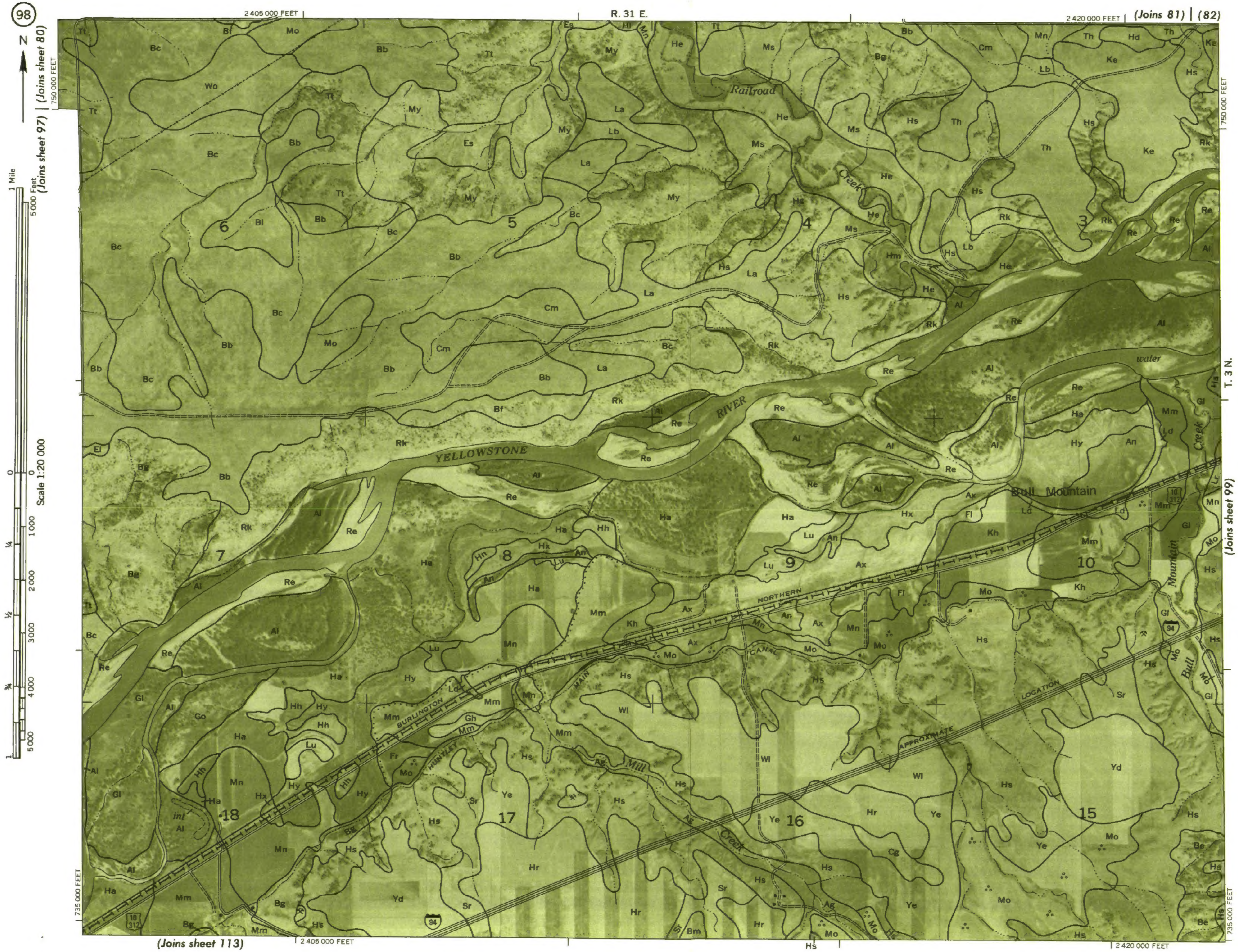
1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.



YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 98

YELLOWSTONE COUNTY, MONTANA NO. 98

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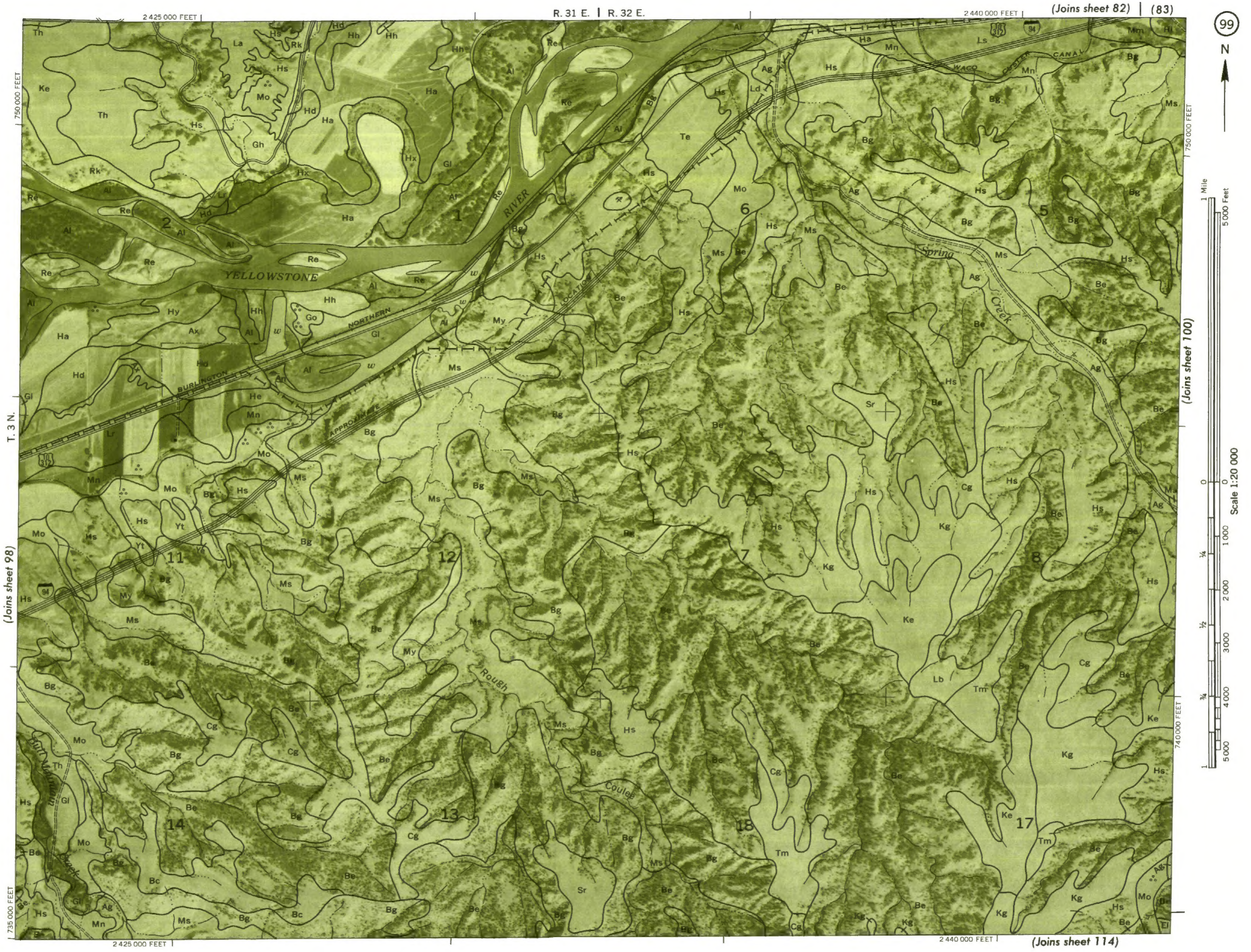
YELLOWSTONE COUNTY, MONTANA NO. 99

Photo base from 1957 aerial photographs. 5,000-foot grid ticks based on Montana plane coordinate system, south zone. 1927 North American datum.

YELLOWSTONE COUNTY, MONTANA — SHEET NUMBER 99



YELLOWSTONE COUNTY, MONTANA

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads

- Dual
- Good motor
- Poor motor
- Trail

Highway markers

- National Interstate
- U. S.
- State or county

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings

- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Microwave tower

Windmill

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line

- Perennial
- Intermittent

Streams, single-line

- Perennial
- Intermittent, unclassified

Irrigation ditch

Drainage ditch

Canals — CANAL

Lakes and ponds

- Perennial — water, w
- Intermittent — int

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

Well, irrigation — I.W.

RELIEF

Escarpments

- Bedrock
- Other

Prominent peak

Depressions, unclassified — Large, Small

SOIL SURVEY DATA

Soil boundary and symbol — Dx

Gravel

Stoniness

- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

Gully

Short steep slope

Borrow pit — B.P.

Gravel pit — G.P.